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ببغداد ٢٢٥ لسنة ١٩٧٥
١٠٠٠ ـ ١٩٧٧/٢/٢٦
مطبعة الزهراء ـ بغداد

Iraqi J. agric. Sci., Vol. XI, 1976

A PRELIMINARY STUDY ON CHAROLAIS X JENUBI (NATIVE) CROSSES

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(Received 30 April 1975)

SUMMARY

Crossbreeding of Jenubi native cows with imported pure French Charolais bulls was attempted for the purpose of increasing meat production. Only the F_1 was produced. Mean body weight of the crossbreds was much higher than that of natives at all ages namely from birth to one year. The final improvement (at one year) was about 55—70 kgs in live weight for males and females respectively.

The crossbreds, under maintenance nutritional regime, showed a mean daily gain of 0.66 $\pm$ 0.03 and 0.62 $\pm$ 0.02 Kg for males and females respectively, and both being less than what is claimed for Charolais cattle.

Dressing percentage was very comparable to that of the purebreds record-

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ed in some other studies. The overall picture and due to the limited number of observations in this study, suggests the necessity for a larger scale investigation with the introduction of other local breeds for comparisons before a final policy can be recommended. A comparison between the Charolais X Jenubi cross with that of the Friesian X Jenubi in terms of gain and weight at a specific age will be of major importance in deciding on such a policy. If they show comparable weights, at a specific age, and this seems to be the case under fattening conditions (El-Dessouky *et al.*, 1975) then due to the additional milk yield, the Friesian cross would be the recommended type for both milk and beef production.

الخلاصـــة

لقد حاولنا في هذه التجربة دراسة تضريب الابقار الجنوبيـــة من ثيران شارولية نقية مستوردة من فرنسا لغرض زيادة وزن الجسم (انتاج اللحوم) · ولقد اكتفينا بالجيل الاول فقط لان من المتوقع وحسب نظريات الوراثة ، ان تنخفض معدلات قوة الهجائن في الجيل الثانى الى النصف ·

لقد دلت النتائج على ان المحاولة ناجحة حيث كانت معدلات اوزان الهجائن اكثر من مماثلاتها من الجنوبى ولمختلف الاعمار التي سجلت منذ الولادة وحتى عمر سنة · وكانت الزيادة النهائية (بعمر سنة) حـــوالى ٥٥ـ٧٠ كغم في وزن الجسم الحى بالنسبة للذكور والاناث بالتعاقب · كما ان معدلات نمو الهجائن اليومية تحت ظروف تغذية بلغت ٠ر٦٦ ± ٠ر٠٣ كغم في الذكور و ٠ر٦٢ ± ٠ر٠٢ كغم في الاناث ، علما بان هذه المعدلات هى اوطىء مما سجل (لنفس الصفة) للشارولية النقي التى ربيت على علائق تسمين خاصة ·

ان نسبة التصافي كانت مقاربة لما سجل للشارولية النقى في دراســـات اخرى · ولكون عدد الحيوانات التى نتجت عن التجربة كان محدودا لذلك فمن الضرورى اجراء تجربة بصورة اوسع بتلقيح عروق محلية اخرى اضـــافة الى الجنوبى قبل التخطيط لتنمية انتاج اللحوم في البلد ·

كما ان المقارنة بين هجائن الشارولية والجنوبى مع هجائن الفـــريزيان والجنوبى في معدل النمو اليومية والوزن عند سنة معينة ضرورية قبل تحـــديد الخطة الخاصة المشار اليها اعلاه ·

فاذا ما اظهرت هجائن الفريزيان اوزان متقاربة مع هجائن الشارولية وهذا ما اتضح من تجربة تسمين مبدئية وبسبب تحصيل كميات حليب اكثر من هجائن الفريزيان فان ذلك يملي انتهاج سياسة الاستمرار على التضريب مع الفريزيان . ولكن لا بأس من تجربة تضريب الشارولية او عروق لحم اخرى مع العروق المحلية المتوفرة في العراق .

INTRODUCTION

Native Iraqi cattle are characterised by poor milk production and small size. One of the important factors contributing to this low productivity is the poor genetic potential.

Upgrading with the Friesians (through A.I.) for more than 10 years to improve milk production gave encouraging results (Kassir *et al.*, 1969). The crossbred Friesians showed larger body weight than the native cattle.

Purebred Charolais bulls were imported from France in 1973 and used on native cows. Beef producing potentials of their halfbreds were investgated.

MATERIALS AND METHODS

A total of 42 Charolais X Jenubi crossbred males and females were used in this study. Their Jenubi dams had at least two previous calvings and were of different ages. They were artificially inseminated and had no calving problems.

The calves were allowed to suckle their dams for four months, and were weaned at six months of age as they attained the normal regime of feeding. Each calf was allowed daily 1.5 kg concentrate (15% crude protein), 10 kg alfalfa, 1 kg wheat straw. Water was available all the time.

Weights at birth, at monthly intervals, and at one year were recorded. Males were slaughtered at about 18—24 months of age. Carcass weight, weight

of different organs and dressing percentage (yield) were obtained. Mean dressing percentage was calculated as percentage of body weight after fasting for about 24 hours. Weights at different ages were compared within sex (crossbreds v.s. Jenubi) and between sexes (crossbred males v.s. females). Crossbreds were also compared with the pure Charolais. Data on the latter were obtained (at their face value) from the Charolais Breed Book, 1973. The problem of contemporaneity had to be overlooked. They were considered to represent a higher limit for the weights compared.

Additional data on birth weight from 14 Jenubi males born at the Basrah Experimental Station situated in the southern part of Iraq, were used to increase the number of observations and to get a better estimate of the mean. In this respect it is worth mentioning that the ranges of values of birth weights were similar for the two groups.

RESULTS AND DISSCUSSION

Growth:

Body weight of animals included in this work is given in Table 1. Regression of body weight at one year on birth weight was calculated for crossbred males and females separately as 6.16 $\pm$ 1.68 and 2.10 $\pm$ 0.06 Kg respectively.

Dressing percentage:

Average age at slaughter ranged from 18—24 months. It should be mentioned that dressing percentage is better calculated as carcass weight relative to empty live-body weight i.e. live-body weight minus the weight of the gut. Only this allows comparison of different groups for the same character, as variation due to the digestive tract is avoided. Weight after fasting was considered in this analysis to be as close as possible to empty weight. In this work dressing percentage in relation to weight after fasting was found to be 54.48 $\pm$ 0.09.

TABLE 1. Mean body weight of crossbred (Charolais X Jenubi) and Jenubi cattle of both sexes at various ages (Kg).

		Charolais X Jenubi	Jenubi	Difference in mean body weight and level of significance (t— test)
At birth	♂♂	27.27 ± 1.06	21.87 ± 1.28	5.40**
	♀♀	29.26 ± 0.75	23.00 ± 0.89	6.26**
3 months	♂♂	82.27 ± 4.73	57.80 ± 5.74	24.47*
	♀♀	76.58 ± 2.34	53.10 ± 4.79	23.48**
6 months	♂♂	140.87 ± 7.57	98.25 ± 6.02	42.62**
	♀♀	142.37 ± 3.58	84.00 ± 8.74	53.37**
9 months	♂♂	206.60 ± 13.18	150.75 ± 11.31	55.85**
	♀♀	197.44 ± 4.24	139.50 ± 12.31	57.94**
12 months	♂♂	251.67 ± 14.29	196.25 ± 15.04	55.42*
	♀♀	249.59 ± 4.70	179.25 ± 20.65	70.34**

* $P < 0.01$ ** $P < 0.001$

For the purpose of comparison, dressing percentage of Charolais bullocks (30 months) is claimed to be 58.5 and for females at the same age was also 58.5 (The Charolais Breed, 1973). Dressing percentage of Jenubi males, about 18 months old is 51.2 ± 2.36 and for Iraqi buffalos, about two years old is 48.4 ± 1.33 when fed special fattening ration (Kassir *et al.*, 1969).

Weight of some organs expressed as percentage of body weight before fasting is presented in Table 2 in comparison to this counterparts for Jenubi cattle and Iraqi buffaloes (Kassir *et al.*, 1969) and for comparative ages.

Regression of yield percentage on weight at each of birth, six months, and one year of age was calculated and found to be 0.213 ± 0.240, 0.029 ± 1.360 and 0.014 ± 0.020 respectively. None of the regression coefficients was significantly different from zero.

Gain:

Relative gain in body weight was calculated as Wt —W(t—1) where Wt is mean weight at a specific age (t) and for monthly periods. Monthly gains for crossbreds (males and females) are shown in Table 3, together with the corresponding standard deviations.

TABLE 2. Mean weight of various organs & components (% of body weight before fasting).

Organ	Charolais X Jenubi cross	Cattle* (Jenubi)	Buffaloes* (Iraqi)
	%	%	%
Liver	1.28 ± 0.09	1.44	1.41
Head	5.48 ± 0.27	3.90	4.06
Legs	2.09 ± 0.09	1.71	2.36
Stomach & intestines	19.33 ± 0.66	20.72	21.48
Lungs	1.60 ± 0.19		
Hide	7.33 ± 0.23	7.84	10.77

* Kassir *et al.*, (1969).

The overall monthly and daily gains (over the entire period) were found to be 19.87 ± 0.94 and 0.66 ± 0.03 Kg for males and 18.66 ± 0.82 and 0.62 ± 0.02 Kg for females respectively. Differences in mean monthly and daily gains between sexes were not significant. Females displayed less variation than males in their growth rate between months and between

TABLE 3. Relative gain in body weight in Charolais X Jenubi calves between birth and one year.

Sex		Age (months)											
		0—1	1—2	2—3	3—4	4—5	5—6	6—7	7—8	8—9	9—10	10—11	11—12
Males	Mean	0.57	0.40	0.39	0.30	0.14	0.16	0.15	0.13	0.10	0.07	0.09	0.08
n = 15	S.D.	0.27	0.23	0.20	0.18	0.07	0.05	0.09	0.04	0.06	0.04	0.03	0.02
Females	Mean	0.45	0.40	0.30	0.28	0.24	0.16	0.13	0.10	0.10	0.08	0.10	0.07
n = 27	S.D.	0.22	0.13	0.15	0.08	0.09	0.05	0.05	0.04	0.04	0.02	0.05	0.03

individuals within months.

Daily and monthly gains for Jenubis were 0.49 ± 0.09 and 14.08 ± 0.93 Kg for males and 0.44 ± 0.05 and 13.02 ± 1.70 Kg for females, respectively. Differences between sexes were not significant. As the degrees of freedom were very few, such figures should be taken with caution. Daily gain for Jenubi males after being fed on a special fattening ration and according to body weight for a period of six months was given as 0.889 ± 0.29 (Kassir *et al.*, 1969). Juma *et al.* (1972) found a daily gain of 0.544 Kg in native cow calves and 0.728 Kg in Iraqi buffalo bull calves after 127.4 and 138.6 days of feeding period.

Daily gain of pure Charolais males as recorded in the "Charolais Breed Book" and for comparative age was 1.2 Kg which is about twice as large as that of the Charolais X Jenubi cross. In a fattening experiment for 120 days, daily gain of such cross amounted to 0.85 Kg which is comparable with that quoted for pure Charolais (Dessouky *et al.*, 1975).

As it can be seen from Table 1 the resemblance between the growth trends of crossbred males and females is quite obvious throught the year. In both cases growth was linear and this probably justifies the calculation of the daily gain by simple division on thirty days per month.

Jenubi males always showed a consistantly higher body weight than females except at birth. The difference in mean body weight at birth between the crossbred and the Jenubi expressed as a ratio to the average body weight of Crossbreds and Jenubi i.e. (Mean body weight of Crossbreds+ Mean body weight of Jenubi)/2 was only one fourth. The difference increased to about one third at about the third month of age (about weaning time). The smaller difference at birth can be attributed to the similarity in the size of maternal effects (the mother being Jenubi in both cases). After weaning, and when the offsprings became independent from their mothers, the difference in mean body weight at similer ages increased and the genotype

of the offspring governed growth pattern.

The authors would like to express their thanks for the Directorate General of Animal Resources for providing the facilities to do this work.

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STUDIES ON BIRTH WEIGHT AND GESTATION PERIOD WITH SPECIAL REFERENCE TO THEIR REPEATABILITY ESTIMATES IN RED DATISH CATTLE

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(Received 10 November 1974)

SUMMARY

A statistical analysis was carried out on birth records collected on a total of 212 purebred and crossbred Red Danish calves born at Naesgaard Agriculture School, Denmark during the period from August 1972 to March 1975.

Males were heavier at birth than females. Sex appeared to be responsible for 11.9 and 4.9% of the total variation in birth weight in the first and second calvings respectively.

Sires from different breeds (Finnish Ayrshire and Holstein Friesian) had an influence on birth weight of their progeny.

Highly significant correlations were found between birth weight and gestation period; the correlation coefficients were 0.334 and 0.308 for first

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and second calvings respectively. The coefficient of regression of birth weight on gestation period was 0.3 kg.

Age of dam at first calving had no significant effect on birth weight of their calves.

A non-significant positive correlation was found between calving interval and birth weight (r = 0.119).

Repeatability of birth weight was 0.069 and of gestation period was 0.166.

الخلاصـــــة

اشتملت هذه الدراسة على تحليل احصائي لـ ٢١٢ سجل لمواليد ابقار الدانماركى الاحمر للفترة الواقعة من آب ١٩٧٢ ولغاية آذار ١٩٧٥ ويمـــكن تلخيص النتائج كما يلى :

كانت الذكور اثقل وزنا عند الولادة من الاناث • ولقد تبـين ان الجنس مسؤول عن ٩ر١١ و ٩ر٤٪ من التغاير في الوزن عنـــد الولادة للولادتين الاولى والثانية على التوالى • كان للثيران المختلفة (الفريزيان والايرشاير) تأثير عـــلى الوزن عند الولادة •

وجد ارتباط معنوى بين الوزن عند الولادة ومدة الحمل وكان المعامل ٣٣٤ر• للولادة الاولى و ٣٠٨ر• للولادة الثانية • وكان معامل انحدار الوزن عند الولادة على فترة الحمل ٣ر• كغم • لم يكن للعمر عند الولادة الاولى تأثير معنوى عـــلى الوزن عند الولادة •

كان ارتباط موجب وغير معنوى بين الوزن عند الولادة والفترة بين الولادتين وكان المعامل يساوى ١١٩ر•

كان المعامل التكرارى للوزن عند الولادة ٠٦٩ر• والمعامل التكرارى لمدة الحمل ١٦٦ر•

INTRODUCTION

Birth weight is economically important because of its relation to calving difficulty, subsequent performance and calf survival (Gregory *et al.*, 1950; and Wilson, 1973). Similarly, gestation period is important especially when

calves are carried extremely long and calving difficulties result, or when calves are born prematurely (Mead *et al.*, 1949 and Gregory *et al.*, 1951).

The object of the present work was to investigate the repeatabilities of birth weight and gestation period in Red Danish cattle, as well as the relationship between them. Furthermore, some factors affecting birth weight such as sex of calf, gestation period, breed of sire and age of dam were studied.

MATERIAL AND METHODS

Data used in this study were collected on a total of 106 Red Danish cows having their first two calvings. Therefore, a total of 212 purebred and crossbred Red Danish calves have been included in this analysis. All records were obtained from the herd at Naesgaard Agriculture School, Denmark during the period from August 1972 to March 1975.

The original records were subjected for correction for sex of calves born. Since the sires of the calves were of three different breeds (Finnish Ayrshire, Holstein Friesian and Red Danish), correction for sire was carried out. Most of the statistical analyses were carried out by NEUCC (Northern European University Computing Centre) using some of the computing programmes included in SAS (Statistical Analysis System).

RESULTS AND DESCUSSION

Effect of sex:

The average birth weight of calves from first and scond calvings for both males and females is given in Table 1. Birth weight of males exceeded those of the females by 3.41 and 2.51 Kg in the first and second calvings respectively. Magnitude of the differences in this study were in agreement with those reported in the literature (Sacker *et al.*, 1971; Willis *et al.*, 1972, and Obta *et al.*, 1973).

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Sex was responsible for 11.9 and 4.9% of the total variation in birth weight in the first and second calvings respectively. Results obtained were in accordance with those of Singh and Tyagi (1970) who stated that 9.38% of the variation in birth weight was due to sex of calf.

TABLE 1. Average birth weight (Kg) of calves from first and second calvings.

	Sequence of calving					
	I			11		
Sex	No.	Mean	S.D.	No.	Mean	S.D.
Female	58	35.57	4.43	49	40.00	5.42
Male	48	38.98	4.92	57	42.51	5.66

Effect of sire:

Due to bulls of different breeds used in crossbreeding with Red Danish cows the effect of sire on birth weight of calves was investigated (Table 2). It can be seen from this table that calves resulting from crossbreeding were superior in birth weight to purebred Red Danish calves by 2.59 and 2.00 Kg for the calves from Finnish Ayrshire X Red Danish and Holstein Friesian X Red Danish respectively in the first calving; consequently for the second calving the crossbreds were heavier at birth by 2.83 and 3.24 Kg respectively and in the same order.

TABLE 2. Average birth weight (Kg) of calves from Red Danish cows and sires of different breeds.

	Breeds of Sires								
	Red Danish			Finnish Ayrshire			Holstein Friesian		
Calving sequence	No.	Mean	SfiD.	No.	Mean	S.D.	No.	Mean	S.D.
I	79	38.42	6.61	9	41.01	3.08	18	40.42	4.23
II	8	39.69	10.00	45	42.52	4.33	53	42.93	5.68

Effect of gestation period:

Bull calves were carried longer than females by 1.46 and 1.07 days in the first and second calvings respectively. Calves from second calving were carried longer than calves from first calving and the difference in gestation was 1.3 and 1.7 days for male and female calves respectively. A highly significant correlation was found between both traits; the correlation coefficients were 0.334 and 0.308 for first and second calvings respectively. Such results are in agreement with those of other investigators (Bodisco and Cevallos, 1971 and Tena Andreu, 1973).

Regression of gestation period on birth weight was also calculated; each additional day in gestation period resulted in an increase of 0.32 and 0.31 Kg in birth weight of calves in the first and second calvings respectively. Similar results have been reported by Reynolds *et al.* (1965).

TABLE 3. Average gestation period (days) for first and second calving in Red Danish Cows.

	Calving sequence					
	I			II		
Sex	No.	X	S.D.	No.	X	S.D.
Male	48	279.63	4.61	57	280.95	5.71
Female	58	278.17	4.79	49	279.88	5.16

Effect of age of dam:

The effect of age of dam at first calving on birth weight was not significant; the correlation coefficient between both traits after correction for both sex and sire was 0.028. Similary, Denis (1971) stated that age at first calving had no significant effect on birth weight. It can be seen from Table 1 that calves born to second calvers were heavier at birth than those born for

heifers; a difference of 3.53 and 4.43 Kg was observed for males and females respectively. Such results are in agreement with those of other workers (Sacker *et al.*, 1971 and Wilson, 1973).

Effect of calving interval:

In the present work the correlation coefficient between calving interval and birth weight was calculated as 0.119 which indicates that cows with longer calving intervals tend to produce heavier calves at birth; this may be due to the fact that cows having longer calving intervals are in better condition, particularly from the nutritional point of view.

Repeatability of birth weight:

Repeatability of birth weight based on data corrected for sex and sire and calculated as the correlation coefficient between birth weight of first and second calves was estimated as 0.069. The estimate obtained here is very close to that (0.07) reported by Juma and Kassir (1967) on Friesian calves in Iraq, and in general is lower than most of the estimates reported in the literature (Table 4).

The repeatability estimate obtained here reflects that heritability of birth weight for the Red Danish calves is low. This low repeatability denotes to the great role played by environmental factors.

Repeatability of gestation period:

In this study the repeatability of gestation period was calculated as the correlation between the first and second gestation periods and it was estimated as 0.166. Similarly, Rendel (1959) estimated the repeatability of the duration of gestation in Swedish cattle, using 3507 gestations as 0.172.

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TABLE 4. Repeatability estimates of birth weight of calves of different breeds.

Breed	Location	No. of records	Repeatability	Worker(s)
Friesian	Iraq	215	0.07	Juma & Kassir (1967)
Japanese	Japan	485	0.10	Kumazaki & Matsukava (1964)
Santa Gertrudis	Cuba	568	0.22	Willis & Wilson (1974)
Santa Gertrudis	Venzuela	629	0.27	Plasse *et al.*, (1968)
Brown Swiss	Venzuela	309	0.33	Bodisco & Cevallos (1971)
Sahiwal	India	557	0.37	Batra & Desai (1962)
Red Danish	Denmark	212	0.069	Present study

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STUDIES ON PARTIAL MILK YIELD RECORDS

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SUMMARY

Data from 26, 181, and 24 first lactation records for Finnish Ayrshire, Red Danish, and Holstein Friesian cows, respectively, were used in this work. The relationships between single and six cumulative monthly parts of lactation with 305-day output in the first and second lactations were investigated.

Friesians produced more milk followed by Red Danish with Ayrshire rating third, while the last-mentioned breed had the highest fat yield followed by Holstein Friesians and Red Danish coming last.

Season and age at first calving influenced part and whole lactations, the effect of age being the greatest in the first month of the lactation period.

The correlation coefficients between a single part and yields over 305 days increased progressively with advancing stages in the lactation period and reached a maximum in the 5th and 6th parts ranging between 0.66—0.93 for butterfat.

The cumulative parts of the 5th and 6th parts or the cumulative parts

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of the 2nd, 4th, and 6th have the same correlations as the cumulative six parts of the lactation period and nearly the same correlation as 305-day records for the first lactation as compared with 305-day records in the second lactation. Thus these indices can be said to be reliable indicators of yield during the 305 days of the first lactation as well as of the 305 days of the second lactation.

الخلاصـــــة

استخدمت بيانات من ٢٦ ، ١٨١ ، ٢٤ سجل كامل للموسم الاول من انتاج الحليب لابقار الايرشاير والدانماركى الاحمر والفريزيان على التوالى في هذه الدراسة بقصد معرفة العلاقة الموجودة بين اجزاء فردية وستة اشهر متجمعة من مرحلة الحليب من جهة مع انتاج الحليب في ٣٠٥ يوم للموسمين الاول والثانى من الانتاج ويمكن تلخيص النتائج كما يلى :

١ ـ اعطت ابقار الفريزيان اعلى انتاجا للحليب تلتها ابقار الدانماركى الاحمر وكانت اقلها ابقار الايرشاير بينما اعطت الابقار الاخيرة اعلى انتاج للدهن بعدها كانت ابقار الفريزيان وكانت آخرها ابقار الدانماركي الاحمر ٠

٢ ـ كان لكل من الموسم والعمر عند الولادة الاولى تأثير على اجزاء مرحلة الحليب وكذلك عـــلى الموســم الانتاجى باكمـــله ٠ وكان اكبـر تأثـير للعمـر في الشهر الاول من مرحلة الحليب ٠

٣ ـ معامل الارتباط بين اجزاء فردية وحاصل الحليب في ٣٠٥ يوم اخذ يزداد بتقدم مرحلة الحليب ووصل الى اعلى قيمة في الجزئين الخامس والسادس وتراوح بين ٦٦ر٠ ـ ٩٣ر٠ لانتـــاج الحليب و ٣٨ر٠ ـ ٩٣ر٠ لحاصل الدهن ٠

٤ ـ كان معامل الارتباط للاجزاء المجمعة من الخامس والسادس او من الثانى والرابع والسادس مع انتاج الحليب والدهن في ٣٠٥ يوم هو نفسه لو استعملت الاجزاء الستة مجمعة ويساوى كذلك تقريبا معامل الارتبـــاط للانتاج في ٣٠٥ يوم بين الموسمين الاول والثانى من الانتاج ٠

وعليه يمكن القول بان الجزئين الخامس والسادس او الثـــانى والرابع والسادس يمكن استعمالها لتقدير الانتاج في ٣٠٥ يوم وللموسمين الاول والثاني٠

INTRODUCTION

The utilization of selection programmes in animal breeding needs knowledge of genetic and phenotypic parameters of the traits involved. In dairy cattle major emphasis should be placed on milk production as a criterion for selection. It appears essential to predict the lifetime production of animals at the earliest possible stage on the basis of allied characters for judicious culling of inferior stock so as to result in profitable dairy farming and the improvement of the herd genetically.

The reliability of the first records as the basis for early selection in a dairy cattle breeding programme is, therefore, very important (Heizer, 1933; Johannson and Hansson, 1940; Johannson, 1955; Johnson and Corley, 1961; Robertson and Khishin, 1958).

Part lactation records, on the other hand, seem to have an important role in dairy cattle selection, both evaluation of sires and of cows (Gowen and Gowen, 1922; Johnson and Corley, 1961; Madden *et al.*, 1955: Searle, 1961; Van Vleck and Henderson, 1961 a and b.).

The knowledge of factors affecting part and whole lactation yields is of great importance in the process of adjusting these records. A number of non- genetic factors have previously been found to influence milk production significantly, so prior to genetic studies or estimation of breeding values, the effect of these non-genetic factors should be removed in some way. The most commonly studied environmental factors affecting milk production are age, season or month of calving, breed and herd (Appleman *et al.*, 1969; Lamb and McGillard, 1960; Lamb and McGillard, 1967; McDaniel *et al.*, 1967).

The aim of the present investigation was to study the factors which affect partial lactation yield such as age, season, and breed; phenotypic correlation as well as repeatabilities were also studied. Furthermore, a

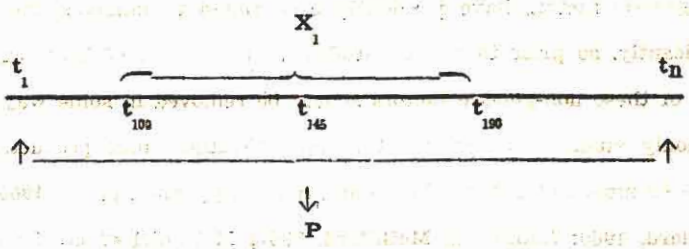
regression equation to predict total milk production from partial milk yield was formulated.

MATERIALS AND METHODS

Data for the present study were obtained from the first and second 305-day lactation milk and butterfat records of three breeds namely, Finnish Ayrshire, Red Danish and Holstein Friesian. All the records were obtained from the herd at Naesgaard Agricultural School over the period from August 1972 to December 1974, and consisted of 26, 181, and 24 first lactations of 305 days for the Finnish Ayrshire, Red Danish and Holstein Friesian respectively. The corresponding numbers for the second lactation were 15, 50, and 12. The first 180 days of the lactation were divided into six periods (each of 30 days) both for milk yield and butterfat production.

The original records were firstly subjected to correction for season of calving as follows:

For each single day in the whole period (approximately 500 days) the average butterfat yield of all cows which had calved in a 91 day period, consisting of the day in question ± 45 days were calculated. The ratio between the mean for all cows and the mean for each 91 day period (i. e. one for each day in the period) was used as a multiplicative correction. In this way each cow was compared to all cows which had calved in the period 45 days before and 45 days after the date of calving of the particular cow in question and as in the example below.



where,

P = mean for all cows which have calved during the period day t_1 to t_n.

X = mean of all cows which have calved during the period $t_{190} - t_{190}$.

$\frac{P}{X_1}$ = is the multiplicative correction factor for cows calving at day t_{145}.

It was assumed that the correlation between season of calving and age at calving is zero. After the correction for season was carried out, the corrected data were further corrected for age at first calving according to the following formula:—

Age corrected yield = $(X - X_i)\, b + y_i$

where,

X = the average age at first calving for the breed.

X_i = the age of the i cow at first calving.

b = the regression of yield on age at first calving.

y_i = the yield of the i cow.

Most of the statistical analyses were carried out by NEUCC (Northern European University Computing Centre) using some of the computing programmes included in SAS (Statistical Analysis System).

RESULTS AND DISCUSSION

The average — uncorrected part — and 305 day milk yield and butterfat production in the first lactation for the three breeds studied are given in Table 1. From the table it can be concluded that the highest yield for the three breeds occured in the second month of the lactation, and this is in accordance with the normal lactation curve for dairy cows. Furthermore, it was manifested that Friesian cows were the highest producers in respect of milk followed by Red Danish finally Finnish Ayrshires. With respect to butterfat production, however, Finnish Ayrshires came first followed by Friesians and with Red Danish last. These results are obviously due to the differences in the fat percentage of the milk produced by the three breeds. Table 1 also shows that the coefficients of variability were less for Finnish Ayrshires in comparison with the other two breeds with respect to both milk

and butterfat yields; this means that Finnish Ayrshire cows are more homogeneous than Red Danish and Friesian cows with respect to milk and butterfat production. As regards persistency, it appears from Table 1 that there are differences between the breeds in question in that Finnish Ayrshires are more persistant than Red Danish which in turn exhibit a greater persistency than Holstein Friesians.

Effect of Season

It has been pointed out in the literature that month of calving influences the milking performance. This effect may vary with respect to different districts and is caused mainly by the seasonal variations in feeding and management (Berskin and Freeman, 1965; Hickman and Henderson, 1955; and Syrstad, 1965). Consequently, the present data were corrected for seasonal effects, and, as mentioned, this correction was carried out multiplicatively and the correction factors are given in Figure 1. It can be seen from this that there was a seasonal fluctuation and that the highest yields were obtained from cows which had calved between February and May, while the lowest production occured for cows calving between July and November. Similar results have been reported in the literature (Appleman *et al.*, 1969; Keown and Van Vleck, 1973; and Lamb and McGillard, and 1967) in which they stated that season of freshening should be considered in extending partial records to 305 day records.

Effect of Age at First Calving:

The phenotypic correlation and regression of milk and butterfat on age were calculated and the results are given in Tables 2 and 3. It can be seen from Table 2, there was a positive correlation between these traits (except in the case of Friesian cows for which there was a slightly negative correlation, which was due first and foremost to one single cow which calved at a very early age and produced the highest yield in comparison with the rest of the cows

Figure 2. Graphical representation of the correction factors for season

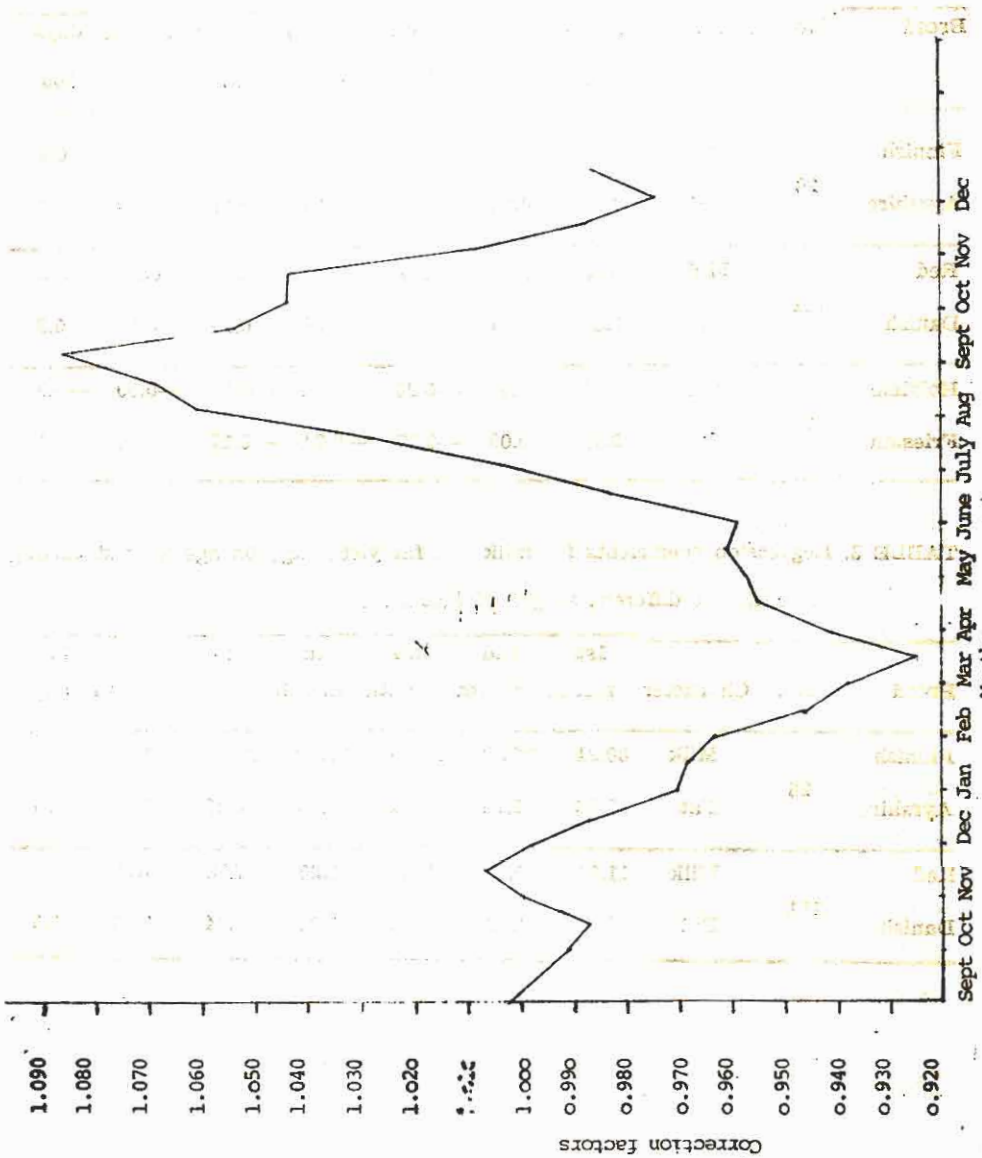


TABLE 2. Phenotypic correlation coefficients between age at first calving and milk and fat yields at different stages of the lactation period for different breeds.

Breed	No.	Character	month 1st	month 2nd	month 3th	month 4th	month 5th	month 6th	days 305
Finnish Ayrshire	26	Milk	0.39	0.25	0.23	0.28	0.27	0.33	0.3
		Fat	0.35	0.28	0.25	0.15	0.16	0.44	0.4
Red Danish	181	Milk	0.44	0.38	0.25	0.28	0.32	0.30	0.3
		Fat	0.31	0.31	0.24	0.22	0.24	0.24	0.2
Holstein Friesian	24	Milk	—0.30	—0.06	—0.23	—0.24	—0.14	—0.09	—0.2
		Fat	—0.25	—0.05	—0.07	—0.04	—0.17	—0.06	—0.1

TABLE 3. Regression coefficients for milk and fat yield (kg) on age at first calving (month) at different stages of lactation.

Breed	No.	Character	1st month	2nd month	3th month	4th month	5th month	6th month	305 days
Finnish Ayrshire	26	Milk	30.21	16.50	17.70	18.78	14.70	21.81	228.6
		Fat	1.26	0.78	0.54	0.45	0.42	1.38	10.7
Red Danish	181	Milk	11.04	9.63	7.65	7.20	7.98	7.20	69.7
		Fat	0.36	0.36	0.30	0.27	0.24	0.24	2.5

involved in this study). The correlation was highest for the first month after calving and then a gradual decline sets in the second month following which the figure remains almost steady for the rest of the periods under review. From Table 3 it appears that an increase of one month in age at first calving is responsible for a rise of 30.2 Kg milk and 1.26 Kg butterfat in the Ayrshires and 11.0 Kg milk and 0.36 Kg butterfat in Red Danish for the first month after calving, while for the whole period (305 days) an increase by one month in age at first calving led to an increase of 228.7 and 10.77 Kg milk and butterfat in the Ayrshires and 69.75 and 2.58 Kg in the case of Red Danish. The results obtained from this study were in agreement with results reported in the literature (Auran, 1973; and Keown and Van Vleck, 1973).

Relationship between partial yields in first lactation and 305 day yields of milk and butterfat in the first and second lactations.

In order to estimate the relationships between each of the six partial yields and 305-day yields, the phenotypic correlations have been calculated on the basis of the season and age corrected data. The results are given in Tables 4 and 5. From Table 4 it can be seen that there was highly positive correlation between part and full lactations, and the coefficient of correlations increased steadily with advancing stage of lactation and reached a maximum at the 5th and 6th periods. This may be due to the fact that in earlier stages of lactation the effect of environmental factors on these traits is greater. From the correlations the conclusion may also be drawn that the single 4th, 5th, 6th parts of the lactation period can be used as an indicator for a prediction of the 305-day yield of milk and butterfat. These single parts also have a relatively high correlation coefficient with the second lactation (Table 5) in comparison with the correlation coefficients of the 305-day milk or butterfat yields. This means that single parts, and especially the 5th and 6th parts of the lactation period gave the same prediction for the second lactation as did the first 305-day lactation period. Results obtained in this study were in agreement with earlier work carried out by many investigators (Fritz *et al.*, 1960; Hooven *et al.*, 1972; Van Vleck and Henderson 1961a).

TABLE 4. Phenotypic correlation coefficients between milk yield in different parts of the lactation period and 305-day yields during the first lactation as well as fat yields in the different parts of lactation with 305-day fat production.

Breed	No.	Character	1st month	2nd month	3th month	4th month	5th month	6th month
Finnish Ayrshire	26	Milk	0.68	0.75	0.82	0.89	0.89	0.91
		Fat	0.38	0.60	0.75	0.86	0.83	0.82
Red Danish	181	Milk	0.66	0.82	0.79	0.83	0.88	0.87
		Fat	0.66	0.72	0.72	0.79	0.85	0.84
Holstein Friesian	24	Milk	0.70	0.79	0.95	0.93	0.92	0.92
		Fat	0.53	0.65	0.84	0.83	0.93	0.92

TABLE 5. Phenotypic correlations between different parts of lactation, 305-day yields of first lactation, and 305-day milk yield of second lactation, as well as fat yields in different parts, 305-day of first lactation and 305-day fat yield of second lactation in different breeds.

Breed	No.	Character	1st month	2nd month	3th month	4th month	5th month	6th month	305 days
Finnish Ayrshire	15	Milk	0.23	0.47	0.21	0.48	0.24	0.41	0.51
		Fat	0.37	0.30	0.47	0.56	0.47	0.56	0.67
Red Danish	50	Milk	0.22	0.34	0.33	0.36	0.45	0.53	0.46
		Fat	0.11	0.16	0.30	0.28	0.42	0.47	0.47
Holstein Friesian	12	Milk	0.55	0.58	0.62	0.64	0.71	0.67	0.67
		Fat	0.36	0.41	0.47	0.67	0.76	0.70	0.67

LE 1. The average age at first calving (months), uncorrected partial and 305 day milk and buttergat yields (Kg) for first lactation in different breeds.

	No.	Age at first calving			No.	Character	1st 30 days			2nd 30 days			3rd 30 days			4th 30 days			5th 30 days			6th 30 days			305 days		
		X	Sx	CV%			X	Sx	CV%	X	Sx	CV%	X	Sx	CV%	X	Sx	CV%	X	Sx	CV%	X	Sx	CV%	X	Sx	CV%
h																											
ire	26	777	38	4.9	26	Milk	453	95	21.0	507	81	15.9	505	96	19.1	486	82	16.9	479	69	14.3	467	83	17.7	4618	743	16.1
						Fat	20.1	4.5	22.7	22.0	3.4	15.8	22.0	3.2	14.6	21.5	3.7	17.3	20.8	3.1	15.3	20.4	3.9	19.1	201.6	29.2	14.5
	145	883	142	16.1	181	Milk	484	109	22.5	523	108	20.6	508	132	26.0	500	113	22.5	489	105	21.5	465	101	21.8	4626	926	20.0
						Fat	20.7	5.0	24.4	21.2	5.0	23.7	203	5.4	26.9	19.7	4.8	24.6	19.1	4.0	21.0	18.5	3.9	21.4	187.5	37.7	20.1
n																											
n	24	968	83	8.6	24	Milk	535	151	28.1	580	116	19.9	565	117	20.6	530	117	22.0	500	128	25.5	479	126	26.2	4845	1130	23.3
						Fat	21.3	6.1	28.6	22.3	4.6	20.9	21.5	4.9	22.9	20.8	4.6	22.4	19.9	4.7	23.9	18.4	4.6	25.3	191.5	42.1	21.9

Repeatability estimates for milk yield over a 305-day period calculated as the phenotypic correlation between first and second lactations were 0.51, 0.46, and 0.67 for the Finnish Ayrshire, Red Danish and Friesian respectively and repeatability of butterfat yield was 0.67, 0.47, and 0.67, in the same order.

Relationship between different cumulative parts of first lactation and 305-day milk and butterfat yields in first and second lactations.

Phenotypic correlations between different cumulative parts of first lactation and 305-day milk and butterfat yields were calculated and are presented in Tables 6 and 7. From these tables it can be concluded that the correlation coefficients rose with increasing numbers of part-lactations included. The results obtained here were in accordance with the results reported by Fritz *et al.*, (1960) who stated that the correlation between cumulative part and 305-day production was not less than 0.70 for the first month rising steadily at the lactation period progressed and reached 0.9 by the 5th test day.

The correlation coefficients obtained from the 5th and 6th parts alone, as well as the cumulative parts of the 2nd, 4th and 6th parts are generally the same, as the correlation of six cumulative parts of lactations so in this respect one can draw a conclusion that either the 5th and 6th periods or the cumulative parts of the 2nd, 4th and 6th periods can be used to predict the total yield for both the first and the second lactations. The results of the prediction of the second lactation have the same accuracy if one uses either the six cumumlative parts, the 5th and 6th parts, or the cumulative of the 2nd, 4th, and 6th parts of lactation, and even when the 305 days of the first lactation form the basis for predictions of yields.

TABLE 6. Phenotypic correlations between milk yields of different cumulative months in the first lactation and 305-day milk yields in the first lactation as well as fat yields of different cumulative months in the first lactation and 305-day fat yields in the first lactation.

Breed	No.	Character	1+2 months	1+2+3 months	1+2+ 3+4 months	1+2+3+ 4+5 months	1+2+3+ 4+5+6 months	5+6 months	2+4+6 months
Finnish Ayrshire	26	Milk	0.77	0.83	0.87	0.91	0.94	0.93	0.95
		Fat	0.52	0.65	0.77	0.84	0.91	0.91	0.95
Red Danish	181	Milk	0.79	0.86	0.88	0.90	0.93	0.91	0.93
		Fat	0.76	0.84	0.88	0.90	0.93	0.89	0.93
Holstein Friesian	24	Milk	0.77	0.86	0.91	0.94	0.96	0.93	0.96
		Fat	0.63	0.75	0.83	0.89	0.93	0.94	0.94

TABLE 7. Phenotypic correlations between milk yield of different cumulative months in the first lactation and 305-day milk yields in the second lactation as well as fat yields of different cumulative months in the first lactation with 305-day fat yields in the second lactation.

Breed	No.	Character	1+2 months	1+2+3 months	1+2+ 3+4 months	1+2+3+ 4+5 months	1+2+3+ 4+5+6 months	5+6 months	2+4+6 months
Finnish Ayrshire	15	Milk	0.37	0.33	0.38	0.36	0.39	0.36	0.51
		Fat	0.34	0.42	0.50	0.52	0.58	0.55	0.60
Red Danish	50	Milk	0.30	0.35	0.36	0.38	0.41	0.50	0.44
		Fat	0.16	0.25	0.29	0.32	0.36	0.46	0.35
Holstein Friesian	12	Milk	0.58	0.61	0.64	0.67	0.68	0.69	0.67
		Fat	0.41	0.46	0.57	0.64	0.66	0.74	0.68

Regression equations to predict the 305-day milk and butterfat yields in the first and second lactations.

For practical purposes different regression equations have been calculated to predict 305-day milk and butterfat yields for the first and second lactations using different cumulative parts of the first lactation. These equations are given in Table 8.

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Ayrshire	y = 1041.761	+2.433	M3	y = 1925.828	+1.784	M3	y =	79.825	+1.895	M3	y = 38.775 +2.331 M3
	y = 775.932	+1.967	M4	y = 1454.913	+1.581	M4	y =	52.869	+1.735	M4	y = 24.418 +1.919 M4
	y = 362.665	+1.750	M5	y = 1448.366	+1.273	M5	y =	32.721	+1.586	M5	y = —10.319 +1.878 M5
	y = 131.180	+1.548	M6	y = 1244.769	+1.139	M6	y =	13.695	+1.481	M6	y = —30.251 +1.736 M6
	y = 228.928	+4.637	M5+6	y = 1792.023	+2.908	M5+6	y =	37.374	+3.981	M5+6	y = 28.061 +3.959 M5+6
	y = 86.730	+3.102	M2+4+6	y = 399.996	+2.844	M2+4+6	y =	12.663	+2.955	M2+4+6	y = —24.303 +3.383 M2+4+
Red Danish	y = 796.136	+3.803	M2	y = 3155.982	+1.753	M2	y =	52.570	+3.215	M2	y = 162.311 +0.931 M2
	y = 598.418	+2.659	M3	y = 3130.081	+1.195	M3	y =	35.590	+2.440	M3	y = 136.937 +1.052 M3
	y = 497.563	+2.050	M4	y = 3012.006	+0.959	M4	y =	26.463	+1.965	M4	y = 125.835 +0.941 M4
	y = 344.976	+1.711	M5	y = 2821.542	+0.845	M5	y =	17.903	+1.677	M5	y = 112.207 +0.897 M5
	y = —7.475	+1.562	M6	y = 2566.120	+0.796	M6	y =	7.104	+1.507	M6	y = 96.924 +0.881 M6
	y = 555.974	+4.269	M5+6	y = 1841.179	+3.180	M5+6	y =	24.076	+4.325	M5+6	y = 62.338 +3.625 M5+6
	y = 129.071	+3.024	M2+4+6	y = 1682.892	+1.745	M2+4+6	y =	9.510	+2.990	M2+4+6	y = 103.212 +1.642 M2+4-
Holstein	y = 1094.043	+3.327	M2	y = 1799.209	+2.694	M2	y =	68.552	+2.756	M2	y = 80.149 +2.611 M2
	y = 291.504	+2.702	M3	y = 1467.487	+2.014	M3	y =	39.047	+2.314	M3	y = 63.410 +2.036 M3
	y = -122.450	+2.248	M4	y = 1254.851	+1.639	M4	y =	13.111	+2.066	M4	y = 19.562 +2.063 M4
	y = -254.734	+1.884	M5	y = 1186.455	+1.376	M5	y =	—1.733	+1.822	M5	y = 10.600 +1.769 M5
	y = -330.799	+1.626	M6	y = 1255,369	+1.166	M6	y =	11.827	+1.636	M6	y = 15.172 +1.477 M6
	y = 554.631	+4.367	M5+6	y = 1902.037	+2.227	M5+6	y =	23.909	+4.345	M5+6	y = 54.124 +3.836 M5+6
	y = 472.047	+3.356	M2+4+6	y = 1194.230	+2.373	M2+4+6	y =	—17.394	+3.398	M2+4+6	y = 13.513 +3.046 M2+4-

where:—

y = 305-day milk or butterfat yield.

M2 = Cumulative month of 1st and 2nd month of lactation.

M3 = Cumulative month of 1st, 2nd and 3rd month of lactation.

M4 = Cumulative month of 1st, 2nd, 3rd and 4th month of lactation.

M5 = Cumulative month of 1st, 2nd, 3rd, 4th and 5th month of lactation.

M6 = Cumulative month of 1st, 2nd, 3rd, 4th, 5th and 6th month of lactation.

M5+6 = Cumulative month of 5th and 6th month of lactation.

M2+4+6 = Cumulative month of 2nd, 4th and 6th month of lactation.

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FATTENING CHARACTERISTICS OF NATIVE CATTLE FED DIFFERENT ROUGHAGES[1]

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SUMMARY

A fattening trial was carried out at the College of Agriculture Farm in Ameria on 48 Iraqi native bull calves, 1.5—2.0 years old and 159.0—218.5 Kg in liveweight. Three types of roughages and two levels of concentrates were used in this study. Digestion trials were carried out on 6 one year old Awassi rams, to determine the digestibility values for the rations used in the present work.

The daily total ration intake values were 57.6, 42.0 and 44.5 Kg for the groups receiving 1% concentrate, plus hay, beet pulp, or straw respectively. Whereas, in the case of those receiving 2% concentrate, the values were 48.4, 48.9, and 45.2 Kg for the other three groups receiving the roughages in the same order respectively.

The hay group receiving 1% concentrate excelled the others in daily liveweight gain, while the straw group receiving 1% concentrate had the least daily gain.

The 2% concentrate level provided increase dressing percentage, rib-eye area values, and feed digestibilities for the three different roughages.

1. Part of M.Sc. thesis submitted by the Senior author.

الخلاصـــــة

اجريت تجربة على (٤٨) عجلا محليا تتراوح اعمارها بين (٥ر١ ــ ٠ر٢) سنة وباوزان تتراوح بين ١٥٩ ــ ٥ر٢١٨ كغم وذلك لدراسة المقارنة بين انواع ثلاثة من الاعلاف الخشنة هى دريس الجت وتبين الشعير وتلف البنجر السكرى (بقايا سكر البنجر) ومدى صلاحية كل منها في عليقة تسمين العجول ٠

قسمت العجول الى ثلاثة مجاميع رئيسية متساوية من حيث العدد ، وتميزت كل مجموعة عن الاخرى بنوع العلف الخشن الذى تناولته ، وقسمت عجول كل من المجاميع البالغ عددها (١٦) في حضيرتين بحيث كانت ٨ عجول في كل حضيرة٠ اعطيت عجول احدى حضيرتى كل مجموعة ١٪ وعجول الحضيرة الاخرى ٢٪ من اوزانها من نفس العليقة المركزة المتكونة من ٧٧٪ شعير مجروش و ١٥٪ نخالة حنطة و٦٪ كسبة فستق الحقل و ١٪ ملح الطعام و ١٪ مسحوق حجر الكلس ٠ اما الاعلاف الخشنة فقدمت الى العجول بالكميات التى تتمكن من استهلاكها ٠

بعد انتهاء فترة التسمين البالغة (٩٨) يوما ذبحت جميع العجول واخذت قياسات معينة على الذبيحة ٠ كذلك اجريت تجارب هضم على ٦ اكباش عواسية بعمر حوالى سنة واحدة لتقدير نسبة الهضم لكل من العليقات الســـتة التى استعملت في تسمين العجول في التجربة المذكورة اعلاه ٠

من نتائج التجربة وجد بان معدل الاستهلاك اليومى من العلف هى ٦ر٥٧ ، ٤٢ ، ٥ر٤٤ كغم للمجاميع الثلاثة التى اعطيت ١٪ من اوزانها علف مركز مع دريس جت او تبن الشعير او تلف البنجر السكرى على التوالى واما بالنسبة للمجاميع الثلاثة الاخرى التى اعطيت ٢٪ من اوزانها علف مركز فكانت معدلات الاستهلاك ٤ر٤٨ ، ٦ر٤٨ ، ٢ر٤٥ كغم للمجاميع حسب الترتيب المذكور بالنسبة لنوع العلف الخشن ٠ وكذلك وجد بان عجول المجموعة التى اعطيت العليقـــة المتكونة من دريس الجت مع ١٪ من اوزانها علف مركز تفوقت على عجول المجاميع الاخرى في الزيادة اليومية في اوزانها ومعدل التحويل الغذائي ٠ بينما مجموعة التبن مع ١٪ علف مركز كانت اول المجاميع في الزيادة اليومية في اوزانها ٠

ان اعطاء العلف المركز بنسبة ٢٪ من اوزان العجول سبب زيادة في نسبة التصافي وارتفاع قيمة المساحة العضلية العينية وزيادة نسبة الهضم في عليقات الدريس والتبن وتلف البنجر السكرى ٠

INTRODUCTION

The livestock industry contributes a high percentage of Iraq's national income from agriculture. This contribution in 1961 was about 47% of the national income from agriculture (Haseeb, 1964).

The interest in evaluating rations for fattening cattle and sheep has been stimulated by recent developments in meat production, to meet the increasing demands of the consumers.

To make use of some agricultural by-products through efficient feeding of farm animals, research work is needed to evaluate such by-products. Therefore, sugar beet pulp and barley straw which are both available in large amounts in Iraq have been included in the present study as by-products constituting good parts of fattening ration.

In order to develop suitable and economical diets for fattening native cattle, the present work has been carried out and designed to provide preliminary information on the relationships among different dietary proportions of roughages and concentrates and some fattening characteristics in native cattle.

MATERIALS AND METHODS

Feeding trial

A total of 48 native bull calves, 1.5 — 2.0 years of age and 159—218.5 Kg in body weight were used. Age of each animal was determined by the teething method. The calves were divided into three main roughage groups of 16 calves each, and placed in six similar pens each containing eight calves, pertaining to each group. The number of treatments was six, and the average initial body weight was 189.5 Kg for the calves in each pen.

The area of each pen was about 10X4 meters. Each pen contained a feed trough desinged for feeding 8 calves at the same time and contained a cement water trough (90 X 30 cm).

The calves in each group received alfalfa hay, sugar beet pulp or barley straw *ad libitum*. The roughages were neither chopped nor ground. Loose alfalfa hay was used. Calves in one of the two pens of each roughage group received 1%, while those in the other pen received 2% of their body weights of the same concentrate mixture. The mixture consisted of 77% ground barley, 15% wheat bran, 6% peanut meal, 1% salt and 1% limestone. A cubic block of trace minerals provided free licks in each pen. The chemical analyses of the feed stuffs used are presented in Table 1.

TABLE 1. Proximate analyses of the feed stuffs

Components %	Feed stuffs					
	Alfalfa hay	Sugar beet pulp	Barley straw	Ground barley	Wheat bran	Peanut meal
Dry matter	84.1	93.0	93.4	92.7	92.7	94.2
Ash	10.8	4.2	12.9	7.2	8.2	5.9
Crude protein	16.5	8.3	3.7	10.7	17.0	62.9
Ether extract	3.3	0.6	1.1	1.2	2.0	0.6
Crude fiber	24.7	21.8	30.1	5.5	10.2	3.7
N F E	44.7	65.2	52.3	79.9	62.7	26.8

The concentrate mixture was offered daily at 8 a.m. and 4 p.m. whereas the roughage was offered in the same feed trough after the concentrate had been cleaned up by the calves of each pen. The concrete floor of each pen was cleaned and abundant clean fresh water was supplied once daily.

Body weight of each calf was obtained after fasting for about 16h, on 2 consecutive days at the begining and the end of the fattening experiment and at two-week intervals throughout the experimental period. Maximum and minimum daily temperatures as well as relative humidity of the ambient were recorded by a hygrothermograph apparatus set on the wall of one of the pens. Moisture contents of alfalfa hay and barley straw were determined daily in

the laboratory, whereas that of dried sugar beet pulp was determined only at the end of the feeding trial.

The final body weights of all calves were taken at the termination of the 98-day feeding period. Five days after the termination of the feeding trial eighteen calves were slaughtered on three successive days. Six calves, one from each pen were taken at random, daily weighed and slaughtered after fasting them for 16h. On the 13th day after the termination of the feeding period, and due to inconvenient facilities, the remaining thirty calves were slaughtered at the abbattoir of the Dairy Administration which is located about 10 km west of the college farm.

Slaughter and hot carcass weights of all calves were recorded. All carcasses were chilled in a cooling room at about 3C°. After slaughter, the carcasses were ribbed between the 12th and 13th ribs as described by Orts (1962). All carcass measurements and weights were obtained from both sides of each carcass. The longissimus dorsi muscle area and the adjacent subcutaneous fat thickness (3 measurements) were determined in duplicates as described by Naumann (1952). The longissimus dorsi muscle area was measured by a polar compensating planimeter on a water proof tracing paper. Carcass length was measured (in centimeters) with a steel tape as described by Orts (1962).

Digestion trials

Six one year old Awassi rams, averaging 49 Kg in body weight, were used for digestibility determination. The conventional method (using metabolism crates) was applied. The rams were alloted at random; two rams were assigned to each of the six experimental rations.

The amount of feed offered to each experimental ram was calculated to meet the maintenance requirements. The roughage and concentrate of each treatment diet were fed to the rams in the same ratio obtained from the feed

consumption data of the above fattening trial.

The concentrate mixture was first offered to each animal, then followed by the assigned roughage in the same box, after the animals consumed all concentrate mixture. The diets were offered to all rams once daily during the ten day collection period.

The feed, under study, was offered 10 days before the begining of faecal collection and a total collection period of 10 days was employed (5 days X 2 trials). Digestibility was determined by measurements of the feed intake and quantitative collection of faeces.

The methods employed for proximate analyses of feeds and faeces were baced on those of A.O.A.C. (1970).

The statistical analyses of the experimental data were carried out as described by Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

The high level of concentrates offered to calves in all groups caused decline in consumption of roughages (Fig. 1). In a comparison between groups of calves on 1% concentrate, the consumption of alfalfa hay was greater than that of either sugar beet pulp or barley straw. Animals were found to accept alfalfa hay better than either barley straw or sugar beet pulp because of the differences in their palatability. Total consumption of sugar beet pulp was less than either of alfalfa hay or barley straw. The consumption of both alfalfa hay and sugar beet pulp by the calves on 2% concentrate level was approximately the same because calves had taken most of their requirements from the concentrate mixture. But the consumption of barley straw was less than either of alfalfa hay or sugar beet pulp. Similarly, Beardsley *et al.* (1959), Lamming *et al.* (1966) and Key *et al.* (1971) found that level of concentrate affects the roughage consumption of steers.

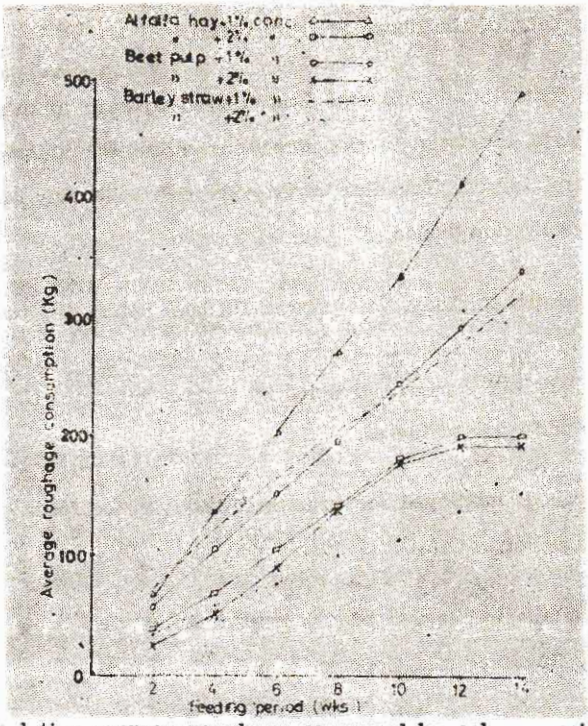

Figure 1 Cumulative average roughage consumed by calves receiving different diets.

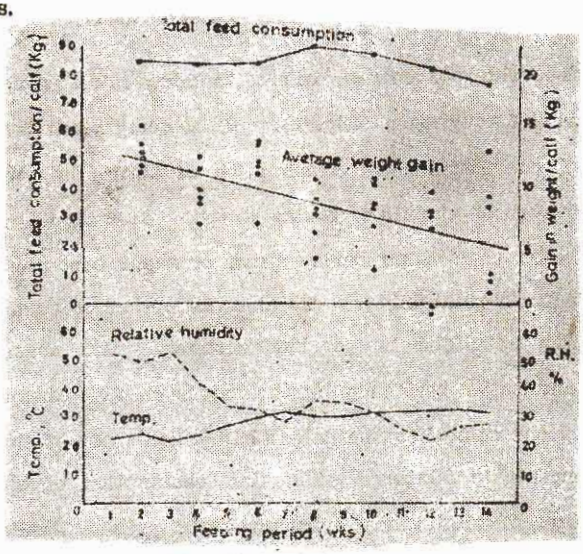

Figure 2. Variation in weight gain and feed consumption compared to mean (max.+min.)/2 daily temperature and mean depression of the wet bulb. Weight gains and feed consumptions expressed per 98-day feeding period.

Total feed consumed at the later part of the fattening pariod decreased gradually (Fig. 2). This may be attributed to the fattening stage at which the calves reached and to the high ambient temperature and low relative humidity during day time, and particularly during the second half of June and throughout July. Hence, the climate of Iraq has been described by Wallen and De Brichambout (1962) as unique and characterized by a long, dry and very hot summer.

Although there were negative and non-significant correlations between feed consumed and mean ambient temperature ($r = -0.096$), Farhan *et al.* (1970) found significant correlations between roughage intake by calves and both of mean ambient temperature and depression of the wet bulb.

The group of calves receiving alfalfa hay plus 1% concentrate was superior and the group receiving barley straw plus 1% concentrate was inferior to other groups with respect to total feed per Kg gain in weight, or to total digestible nutrients (TDN) per Kg gain in weight (Fig 3). The same trend was true in respect to feed or TDN required for one Kg of carcass weight. These results are similar to those of La Toush and Woods (1968). Hayashi *et al.* (1967) found that the level of 1% concentrates improved efficiency of feed conversion by nearly 10%. Swan and Lamming (1967), White and Reynolds (1968) and Nelson and Neumann (1970) indicated that with the increase of straw level in ration the feed conversion ratio of the diet is decreased. Whereas, Pickard *et al.* (1969) and Tillman *et al.* (1969) reported that neither source nor level of roughage affects conversion ratio of the diet.

The calves receiving alfalfa hay plus 1% concentrate were superior and those receiving barley straw plus 1% concentrate were inferior to the others with respect to total gain (Table 2) or average daily gain (Table 2 and Figure 4). Group differences in gain were not significant. These results are in agreement with those obtained by Tillman *et al.* (1969) and White *et al.* (1969). However, Beardsley *et al.* (1959), Lamming *et al.* (1966), Hayashi *et al.* (1967) and White and Reynolds (1969) found that daily gain of calves

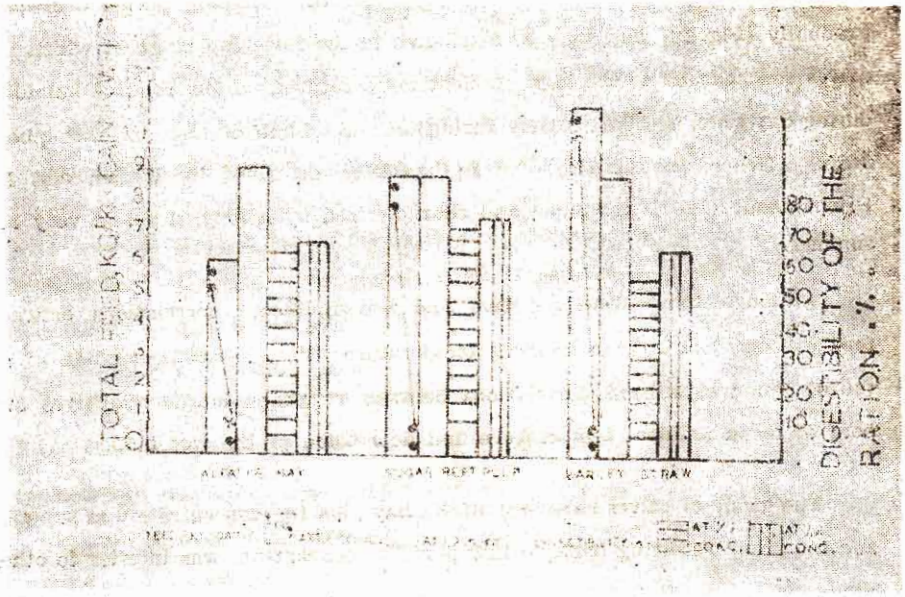

Figure 3. Feed intake per Kg gain and digestion coefficeint of dry matter of the different experimental diets.

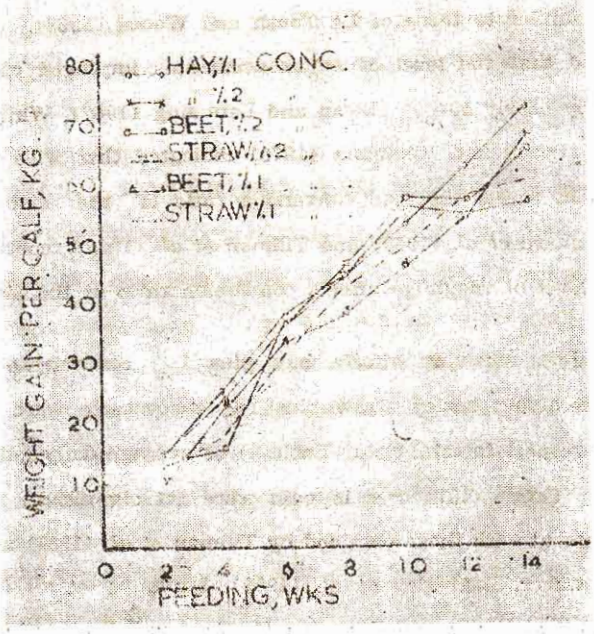

Figure 4. Cumulative average weight gains of calves receiving different diets.

was affected by both of source of roughage and level of concentrates in the diet.

The average gain of calves decreased as mean temperature increased and mean relative humidity decreased (Fig. 2). The correlation between gain and mean ambient temperature was negative and significant ($r = -0.766$) while there was a positive and highly significant correlation between gain in weight and mean relative humidity ($r = 0.835$). Similar results were reported by Farhan and Jumah (1969) and Farhan *et al.* (1970). These workers found that high temperature and very low relative humidity decreased feed intake of calves, and consequently decreased gain.

Certain carcass measurement values are shown in Table 2. Level of concentrate significantly ($P < 0.05$) affected carcass weight. The effect of roughage on carcass weight of calves was highly significant ($P < 0.01$). This finding is similar to that reported by White and Reynolds (1969), White *et al.* (1969), Kay *et al.* (1970 a, b, 1971) and Swan and Lamming (1970). There were positive and non significant correlations between chilled carcass weight and each of daily gain and rib-eye area. This result is similar to that found by El-Shafic and Osman (1971) and Juma *et al.* (1972).

Level of concentrate did not affect dressing percentage while the roughage source affected the value significantly ($P < 0.05$). However, a non-significant negative correlation ($r = -0.309$) was found between final weight and dressing percentage. This may be due to high deposition of fat around the stomach and intestines. Similar results have been reported by Leui *et al.* (1967).

Neither rib-eye area nor fat thickness in the present study was significantly affected by the source of roughage or level of concentrate. Whereas, Haskins *et al.* (1969) reported significant differences in rib-eye area for calves fed different roughages. However, concerning the effect of roughage or concentrate on fat thickness values, similar results have been reported by Tillman *et al.* (1969).

In the present study, positive and non- significat correlations were found between fat thickness and final weight ($r = 0.371$) and fat thickness and rib-eye

TABLE 2. Performance of calves fed different roughages at two levels of concentrates

	1% concentrate			2% concentrate		
	Alfalfa hay	Sugar beet pulp	Barley straw	Alfalfa hay	Sugar beet pulp	Barley straw
No. of calves	8	8	8	8	8	8
No. of days	98	98	98	98	98	98
Initial Wt., Kg	189.8	189.9	189.8	189.9	189.9	189.9
Final Wt., Kg	263.3	246.9	237.2	256.8	256.5	251.2
Av. daily gain, g	750	582	483	683	680	625
Daily feed intake, Kg per group						
Total ration	57.6	42.0	44.5	48.4	48.9	45.2
Roughage	39.7	27.1	26.2	16.3	15.9	12.6
Feed intake per Kg gain, Kg						
Total ration	6.12	9.02	11.27	9.24	9.00	9.04
TDN	4.04	6.66	7.74	6.24	7.06	6.14
Slaughter wt., Kg	253.8	240.1	234.6	254.5	245.4	245.5
Chilled carcass Wt., Kg	137.1	130.6	122.0	143.0	142.8	134.2
Dressing percentage	54.2	54.4	51.9	56.3	56.0	54.6
Fat thickness, mm	4.7	5.0	3.6	5.1	5.2	5.0
Rib-eye area, cm^2	53.2	58.1	53.0	58.9	60.8	59.0
Rib-eye/100 Kg carcass Wt., cm^2	33.8	44.5	43.4	41.2	42.2	44.0
Carcass length, cm	105.3	103.7	103.0	104.3	103.8	103.8

area ($r = 0.220$). In contrast, El-Shafic and Osman (1971) found a significant positive correlation between fat thickness and weight gain and between slaughter weight and weight gain.

The effect of source of roughage or level of concentrate in the diet on the length of carcass was not significant. The correlations between carcass length and each of final weight ($r = 0.641$) and rib-eye area ($r = 0.400$) were not significant.

The results of the digestion trial have demonstrated that the higher concentrate consumption (2% of body weight of animals) increased significantly the digestibilities of most dietary constituents namely, organic matter ($P<0.01$), crude protein ($P < 0.01$), ether extract ($P < 0.05$) and NFE ($P < 0.05$). Such findings are similar to those reported by Dijkstra (1964), Bines and Davey (1970), Kay *et al.* (1970 a, b), Lyonst *et al.* (1970), McCullough (1970) and Swan and Lamming (1970). In contrast, the digestibility of crude fiber was depressed in diets containing alfalfa hay or sugar beet pulp, and improved in the diets containing barley straw when more concentrate (2% of body weight) was consumed by the rams during the digestion trial.

The type of roughage apparently had affected the digestibilities of organic matter and crude protein in diets of the same equivalent level of concentrate. Diets containing sugar beet pulp had the highest percentage of organic matter, followed by diets containing alfalfa hay, and those containing barley straw. While the diets containing alfalfa hay had the highest percentage of crude protein, followed by diets containing sugar beet pulp and those containing barley straw.

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THE EFFECT OF THE PROPORTION OF DATE STONES IN THE DIET ON ITS DIGESTION AND FERMENTATION IN THE SHEEP RUMEN*

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SUMMARY

This study was designed to determine the digestion and fermentation of diets containing different proportions of crushed date stones and immature alfalfa hay. The percentages of date stones in the rations were 0, 25, 50 and 75. Four Awassi rams, one year old (average weight 40 Kg) fitted with permanent rumen fistulas were alloted randomly to different treatments. Each ram received one of the four experimental diets. The experiment extended for four periods, 16 days each, as 4 X 4 Latin square design. The first 10 days of each period was considered as acclimatization period, and days 11—15 collection period to determine the digestibility of the ration. On the 16th day, samples of rumen fluid were taken from the rumen immediately before and at 2, 4, 6, 8, 10, 12 and 24 hours after feeding.

The actual proportions of date stones in the ration were 0, 26, 55, and 73% respectively. Total dry matter intake was slightly increased as the proportions of date stones was increased in the ration.

The apparent digestibility of organic matter for the 0, 25, 50 and 75% date stones were 74.00, 75.56, 76.61 and 77.09% respectively. The corresponding values for crude protein were 80.19, 74.70, 69.04 and 62.25%, for ether

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extract were 22.13, 61.20, 73.91 and 77.61%, for crude fibre were 52.67, 59.65, 62.12 and 67.82%, and for nitrogen free extract were 78.61, 80.09, 81.01 and 80.96%. The values for total digestible nutrients were 65.69, 70.43, 75.02 and 77.68% respectively.

Differences among treatments were statistically significant for all nutrients except of nitrogen free extract.

Digestibility values of date stones which were calculated by difference showed that of the organic matter was 78.35, crude protein 38.55, ether extract 82.03, crude fibre 76.00, nitrogen free extract 81.77 and total digestible nutrients 8.73.

Mean daily pH value in the rumen fluid was slightly depressed with the percentage of date stones being 6.56, 6.42, 6.20 and 6.09 for 0, 25, 50 and 75% date stones in the ration. respectively. Mean pH values decreased by 1.29, 1.05, 0.66 and 0.62 units as a result of increasing the proportion of date stones.

The maximum daily eman concentration of ammonia-nitrogen in rumen fluid was 38.26 (mg/100 ml) at 0% date stones and decreased to 27.48, 17.09 and 10.11 for the 25, 50 and 75% respectively. Differences in ammonia-N content among treatments were highly significant.

The maximum daily mean concentration of total volatile fatty acids was 108 (meq/l) at 0% of date stones in the ration and decreased to 100, 89 and 74 for the other three treatments respectively. Differences among treatments were significant ($p < 0.05$).

Molar percentage of the individual VFAs in rumen fluid revealed a steady decrease in the proportions of acetic acid, being 78.29, 76.99, 74.59 and 64.40 for 0, 25, 50 and 75% date stones. Whereas, values for propionic acid were 18.32, 19.07, 29.48 and 24.81, butyric acid 2.26, 3.04 and 6.04, isovaleric acid 0.33, 0.36, 1.42 and 4.18 and valeric acid 0.38, 0.52, 0.48 and 0.56 for 0, 25, 50

and 75% date stones in the ration respectively. Differences among treatments concerning acetic, propionic, and isovaleric acids were significant.

Acetate to propionate ratio decreased with increased level of date stones in the ration and being 4.3 : 1, 4.1 : 1, 3.7 : 1 and 2.6 : 1 for the four treatments respectively. Narrow acetate to propionate ratio, higher butyric acid, lower total VFAs, and lower pH were observed in the 75% date stones as compared to the other rations.

الخلاصـــــة

اجريت هذه الدراسة لغرض التعرف على درجة الهضم ونوع التخمر الذى يحدث في كرش الاغنام نتيجة التغذية على علائق تحتوى على نسب مختلفة مـن نوى التمر ٠

وقد اجريت هذه الدراسة لغرض معرفة نسبة الهضم ونوع التخمر لعلائق تحتوى على نوى التمر المجروش بنسب مختلفة مع دريس الجت ذى النوعيـــة الجيدة ٠ وكانت نسبة نوى التمر في هذه العلائق : صفر ، ٢٥ ، ٥٠ و ٧٥٪ ٠ أستخدم في هذه التجربة اربعة اكباش عواسي بعمر سنة واحدة وكان متوسط اوزانها (٤٠) كغم ٠ اجريت لهذه الحيوانات عمليات جراحية لفتح الكرش بصورة دائمية وذلك بتثبيت انبوب ذا غطاء محكم بالكرش لغرض الحصول على نماذج للتحليل من المادة العلفية المغذاة ٠ وقد وزعت هذه الاكباش عشوائيا حسب النسب الغذائية المذكورة آنفا ٠ ولقد استمرت التجربة لاربعة فترات كل منها دامت مدة (١٦) يوما ٠ وقد استخدم التصميم الاحصائي لهذه التجربة حسب المربع اللاتيني (٤ × ٤) ٠ حيث اعتبرت الايام العشرة الاولى من الفترات الاربعة كفترة تمهيدية ليتعود الحيوان على هذا النوع من الغذاء ٠ وان فترة جمع الغذاء المتناول والبراز المطروح من الحيوان لتقدير معاملات هضم العناصر الغذائية للعلائق المختلفة فكانت تجرى بين اليوم الحادى عشر ـ والخامس عشر ٠ وفي اليوم (١٦) تم اخذ عينات من الكرش قبل التغذية مباشرة وبعد التغذية بـ ٢ ، ٤ ، ٦ ، ٨ ، ١٠ ، ١٢ ، و ٢٤ ساعة على التوالى لغرض تقدير الاس الهيدروجيني وتركيز الامونيا والمجموع الكلي للاحماض الدهنية الطيارة الناتجـة وكذلك تقدير نسبة الاحماض الدهنية الطيارة المفردة ولقد كانت النتائج تشير الى ما يلي:

وجد بأن النسب المئوية الفعلية لنوى التمر في الغذاء المتناول للمعاملات الاربعة هى : صفر ، ٢٦ ، ٥٥ ، و ٧٣٪ على التوالى ٠ وقد لوحظ وجود زيادة

طفيفة في معدل استهلاك المادة الجافة كلما ارتفعت نسبة نوى التمر في العليقة ٠

ولقد وجدنا بان متوسطات النسب المئوية لمعامل الهضم الظاهرى للمادة العضوية هى ٧٤ر٠٠ ، ٧٥ر٥٦ ، ٧٦ر٦١ ، و ٧٧ر٠٩ للمعاملات : صفر ، ٢٥ ، ٥٠ و ٧٥٪ على التوالى ٠ في حين ان النسب المماثلة للبروتين الخام كانت ٨٠ر١٩ ، ٧٤ر٧٠ ، ٦٩ر٠٤ و ٦٢ر٢٥٪ والدهن ١٣ر٢٢ ، ٢٠ر٦١ ، ٩١ر٧٣ ، و ٦١ر٧٧٪ والالياف الخام ٥٢ر٦٧ ، ٥٩ر٦٥ ، ١٢ر٦٢ ، و ٨٢ر٦٧٪ والكاربوهيدرات السهلة الهضم ٧٨ر٦١ ، ٨٠ر٠٩ ، ٨١ر٠١ ، و ٨٠ر٩٦٪ على التوالى ٠ وقد وجد ان مجموع العناصر الغذائية المهضومة ٦٥ر٦٩ ، ٧٠ر٤٣ ، ٧٥ر٠٢ ، و ٧٧ر٦٨٪ على التوالي ايضا ٠

ولقد اوضحت هذه النتائج بان جميع متوسطات معامل هضم العناصر الغذائية المختلفة تتحسن تدريجيا كلما ازدادت نسبة نوى التمر في العليقة باستثناء معامل هضم البروتين الخام ٠ اما معامل الهضم لمحتويات نوى التمر فقد حصلنا عليه باستعمال طريقة (الفروقات الهضمية) فقد كانت ٧٨ر٣٥٪ للمادة العضوية و ٣٨ر٥٥٪ للبروتين الخام و ٨٢ر٠٣٪ للدهن و ٧٦ر٠٠٪ للالياف الخام و ٨١ر٧٧٪ للكاربوهيدرات السهلة الهضم و ٨١ر٧٣٪ لمجموع العناصر الغذائية المهضومة ٠ وكانت الفروقات لمتوسطات معامل هضم العناصر الغذائية المختلفة معنوية احصائيا باستثناء معامل هضم الكاربوهيدرات السهلة الهضم ٠

وبالنسبة لمتوسط الاس الهيدروجيني اليومي لمحتويات الكرش فقد انخفض انخفاضا طفيفا بزيادة نسبة نوى التمر في العليقة وكان ٦ر٥٦ ، ٦ر٤٢ ، ٦ر٢٠ و ٦ر٠٩ للعلائق التى تحتوى صفر ، ٢٥ ، ٥٠ ، ٧٥٪ من نوى التمر ٠ وقد كان هذا الانخفاض في الاس الهيدروجيني بمقدار ١ر٢٩ ، ١ر٠٥ ، ٠ر٦٦ و ٠ر٦٢ وحدة ويبدو ذلك نتيجة لزيادة نسبة نوى التمر في العلائق ٠

ولقد وجد بان اعلى معدل يومي لتركيز الامونيا داخل كرش الحيوان هو ٣٨ر٢٦ (ملغم/١٠٠ مللتر) عندما كانت نسبة نوى التمر في العليقة صفر ٪ ٠ ثم انخفض التركيز تدريجيا الى ٢٧ر٤٨ ، ١٧ر٠٩ و ١٠ر١١ بأزدياد نسبة نوى التمر في العليقة ٠ وكانت الفروقات في تركيز الامونيا في المعاملات الغذائية المختلفة عالية المعنوية ٠

اما بالنسبة لتركيز الاحماض الدهنية الطيارة المنتجة داخل كرش الحيوان فقد وجد بان اعلى معدل يومي لها هو ١٠٨ (وزن مكافيء غرامي/لتر) عندما كانت النسب المئوية لنوى التمر في العليقة صفرا ٪ ثم انخفض التركيز تدريجيا

الى ١٠٠ ، ٨٩ و ٧٤ في المعاملات الثلاثة الاخرى على التوالي · وكانت الفروقات في تركيز الاحماض الدهنية الطيارة في المعاملات الغذائية المختلفة معنـــوية احصائيا ·

اما النسب الوزنية الجزئية الغرامية للاحماض الدهنية الطيارة المختلفة والمنتجة داخل كرش الحيـــوان فقد انخفضت في حامض الخليك من ٢٩ر٧٨ عندما تكون نسبة نوى التمر في العليقة صفرا ٪ الى ٩٩ر٧٦ ، ٥٩ر٧٤ و ٤٠ر٦٤ في النسب ٢٥ ، ٥٠ ، و ٧٥٪ من نوى التمر على التوالى ·

ولقد كانت النسب الوزنية الجزيئية الغرامية المماثلة لحامض البروبيونيك ٣٢ر١٨ ، ٠٧ر١٩ ، ٤٨ر٢٠ ، ٨١ر٢٤ وحامض البيوتيرك ٢٦ر٢ ، ٠٤ر٣ ، ٠٣ر٣ و ٠٤ر٦ وحامض الايزوفاليرك ٣٣ر٠ ، ٣٦ر٠ ، ٤٢ر١ و ١٨ر٤ وحامض الفاليرك ٣٨ر٠ ، ٥٢ر٠ ، ٤٨ر٠ و ٥٦ر٠ على التوالى وكانت الفروقات بين المعاملات الغذائية بالنسبة لحامض الخليك والبرابيونيك والايزوفاليرك معنوية احصائيا ·

ولقد لوحظ انخفاض نسبة حامض الخليك الى حامض البروبيونيك بزيادة نسبة نوى التمر في العليقة حسب المعدلات ٤ر٣ : ١ ، ١ر٤ : ١ ، ٧ر٣ : ١ ، و٢ر٦ : ١ ، للمعاملات الغذائية الاربعة على التوالى ووجد ان الحيوانات التى غذيت على ٧٥٪ من نوى التمر في العليقة بالمقارنة ببقية الحيوانات التى غذيت عـــلى العلائق الغذائية الاخرى بان نسبة حامض الخليك/حامض البروبيونيـــك ، ومجموع الاحمـــاض الدهنيـــة الطيـــارة ، كذلك تركيز الامونيا والاس الهيدروجيني قد انخفضت في حين ان نسبة حامض البيوتيرك قد زادت ·

INTRODUCTION

Among the many reasons responsible for the shortage of meat in the world, particularly in some developing countries is the shortage of feedstuffs. In the past most of the different plant by-products resulting from industrial processes were ignored as feeds for farm animals. Recently, more attention has been paid towards their inclusion in feeding ration.

In Iraq the annual production of dates is about 400,000 metric tons (Iraqi Dates Administration, 1975), and date stones arising as waste-products from processing industries i.e. date syrup, alcohol, are fed to animals both in Iraq and neighbouring countries.

As early as mid 1930's many workers investigated the potential of date stones and other date by-products in feeding cattle and sheep (Williams 1935; and Harry 1936). Consequently, date stones were used in feeding dairy cattle, calves and sheep (Ali *et al.*, 1954, 1955 and 1956; Farhan and Al-Khalisi 1969; and Farhan and Jumah 1969). Recently Al-Kinani (1974) had demonstrated that feeding crushed date stones promote better growth in Awassi lambs and help reduce feeding expenses.

As information on the type of fermentation of date stones in the rumen is lacking, obtaining such information is essential to furnish a much better understanding of the processes involved in its digestion. Consequently, this study was initiated to investigate the digestion and pattern of fermentation of sheep rations containing different proportions of date stones.

EXPERIMENTAL

Animals and Housing.

Four Awassi rams (one year old, average weight 40 Kg) fitted with permanent rumen fistulas were held in metabolism crates. Feed was offered once daily (8 a.m.), water and mineral blocks were offered libitum. The animals were weighed at biweekly intervals.

Food.

A good quality early cut long alfalfa hay which was sun-cured was used. Date stones were crushed with a roller machine (Transport Meschinen Export-Import, Germany). The amount of feed offered to each experimental ram and the chemical analysis of the feed are given in Tables 1 and 2 respectively.

TABLE 1. The daily amounts of alfalfa hay and date stones offered to each ram during the experiment (g. on fresh basis)

Date stones in the ration	0%	25%	50%	75%
Alfalfa hay	1500	1125	750	375
Date stones	—	330	660	1000

TABLE 2. The chemical composition of alfalfa hay and date stones (g/100g).

On dry matter basis

	Dry matter	Crude protein	Ether extract	Crude fibre	NFE	Ash
Date stones	94.23	7.22	6.93	8.43	73.44	3.98
Alfalfa hay	93.36	27.78	1.57	15.57	44.07	11.01

Experimental Design.

The four rams were alloted randomly, so each ram received one of the four experimental diets. All diets contained alfalfa hay and the proportion of date stones in these diets represented 0, 25, 50 and 75 percent respectively (on fresh weight basis).

The experiment consisted of four periods, 16 days each as 4 X 4 Latin square design. The first 10 days of each period was considered as a control period, followed by 5 days of collection period to determine the digestibility of the ration. On day 16, samples of rumen fluid were taken immediately before and at 2, 4, 6, 8, 10, 12 and 24 hours after feeding.

Determination and Analytical Methods.

Digestibility was determined by the measurement of the food consumed and by quantitative collection of the faeces. Food and faeces were analysed for dry matter, ether extract, crude fibre, nitrogen and ash (A.O.A.C., 1970). Samples of faeces for nitrogen analysis were preserved in acetic acid.

The pH of rumen fluid was taken immediately after its withdraw from the rumen and the digesta was filtered through linen cloth. Individual samples of filtrate were analysed for ammonia (McDermot and Adams, 1954) and total short-chain fatty acids (Annison, 1954) and composite daily sample was prepared to determine individual short-chain fatty acids (Crowther, 1971).

RESULTS AND DISCUSSION

Digestibility.

The apparent digestibility of organic matter, ether extract, crude fiber and nitrogen free extract was progressively improved as the proportion of date stones increased in the ration. Crude protein digestibility, however, was decreased (Table 3). Since date stones contained lower crude fibre as compared with alfalfa hay, increasing percentage of the date stones in the ration would decrease total crude fibre intake, which in turn would result in improving digestibility. In general, digestibility of feedstuffs increased as the percentage of fibre in the ration decreased. However, the digestibility of the forage part of mixed forage and concentrate ration usually decreases the digestibility of the fibre fraction of forage by the addition of concentrate (Blaxter, 1967).

Many experiments indicate that the relative or absolute deficiency of protein will result in a marked reduction of digestible energy (Church, 1975). In ruminants this is probably due to a great extent, to a depressing effect on microbial activity. The speed by which feed protein is hydrolized in the rumen depends on its availability. The action of microbial enzymes in breaking down the structural polysaccharides of plants may help in exposing the protein constituents to microbial attack, and so the availability of protein in herbage may depend on the age and degree of lignification of plants. On the other hand, the proteolytic activity of rumen organisms is not dependent on the protein content of the diet (Warner, 1956), as such, soluble proteins are much more readily attacked than insoluble ones (Chalmers *et al.*, 1954), this is a point of considerable significance as particles of insoluble proteins have a greater opportunity of leaving the rumen before being degraded. It could be concluded, as judged by the above information that the protein of date stones was difficult to hydrolize than that of hay.

As a result of the improved digestibility of orfanic matter with the

inclusion of the date stones, total digestible nutrients of the rations was also improved (Table 3). Similar results were found by Al-Kinani and Alwash (1975) using similar diets to those reported in the present work. Differences among treatments in all nutrients were statistically significant except for that of nitrogen free extract content.

Digestibility of date stones was estimated by the difference from total digestibilities of both alfalfa hay and date stones and alfalfa hay alone. Date stones showed low content of digestible protein, but a surprisingly high digestibility of the other nutrients and consequently total digestible nutrients. Similar results were reported by Richter and Beker (1956) and Al-Kinani and Alwash (1975).

TABLE 3. The apparent digestibility of organic matter, crude protein, ether extract, crude fiber, nitrogen free extract, and total digestible nutrients in sheep given different proportions of date stones (D. S.) and alfalfa hay.

D.S. % in the ration	Organic matter	Crude protein	Ether extract	Crude fibre	Total Nitrogen free extract	Total digestible nutrients
0	74.00^{a}	80.19^{a}	22.13^{a}	52.67^{a}	78.61^{a}	65.69^{a}
25	75.56^{ab}	74.70^{b}	61.20^{b}	59.65^{a}	80.09^{a}	70.43^{b}
50	76.61^{b}	69.04^{c}	73.91^{c}	62.12^{b}	81.01^{a}	75.02^{c}
75	77.09^{b}	62.25^{d}	77.61^{c}	67.82^{b}	80.96^{a}	77.68^{c}
100*	78.35	38.55	82.03	76.00	81.77	81.73

Each value represents a mean of four animals.

Means within each column bearing different superscripts, differ significantly at 5% level of probability.

* Calculated by difference.

TABLE 4. Dry matter intake, pH of rumen fluid, ammonia-nitrogen concentration, total volatile fatty acids, molar percentage of volatile fatty acids, and acetate to propionate ratio in sheep given different proportions of date stones and alfalfa hay.

D.S. % in the ration	D. M. g/day	pH	NH_3 - Nitrogen mg/100 ml.	Total VFA meq/1	Molar Ace.	VFA (%) Pro.	But.	Iso Val.	Val	Acetate: Propionate ratio
0	968.4	6.56a	38.26a	108a	78.29a	18.32a	2.62a	0.33a	0.38a	4.3:1
25	993.5	6.42a	27.48b	100ab	76.99a	19.07a	3.04a	0.36a	0.52a	4.1:1
50	1016.0	6.19a	17.09c	89ab	74.59a	20.48a	3.03a	1.42ab	0.48a	3.7:1
75	1124.3	6.09a	10.11c	74b	64.40b	24.81b	6.04a	4.18b	0.56a	2.6:1

Each value represents the mean of four animals.

Means within each column bearing different superscripts, differ significantly at the 5% level of probability.

TABLE 4. Dry matter intake, pH of rumen fluid, ammonia-nitrogen concentration, total volatile fatty acids, molar percentage of volatile fatty acids, and acetate to propionate ratio in sheep given different proportions of date stones and alfalfa hay.

D.S. % in the ration	D. M. g/day	pH	NH_3 - Nitrogen mg/100 ml.	Total VFA meq/l	Molar Ace.	VFA (%) Pro.	But.	Iso Val.	Val	Acetate: Propionate ratio
0	968.4	6.56a	38.26a	108a	78.29a	18.32a	2.62a	0.33a	0.38a	4.3:1
25	993.5	6.42a	27.48b	100ab	76.99a	19.07a	3.04a	0.36a	0.52a	4.1:1
50	1016.0	6.19a	17.09c	89ab	74.59a	20.48a	3.03a	1.42ab	0.48a	3.7:1
75	1124.3	6.09a	10.11c	74b	64.40b	24.81b	6.04a	4.18b	0.56a	2.6:1

Each value represents the mean of four animals.

Means within each column bearing different superscripts, differ significantly at the 5% level of probability.

Fermentation in the Rumen:

Mean daily pH value in the rumen fluid was slightly depressed with increased level of date stones in the ration (Table 4). Changes in rumen pH reflect the quantities of organic acids that accumulate in the ingesta and the amount of saliva that is produced. The rumen pH to be higher when animals were fed rations with alfalfa hay indicating that rumen fluid from alfalfa hay-fed animals has a higher buffering capacity (Brigg *et al.*, 1957). It is generally assumed that the secretion of saliva decreases as the percentage of date stones increases in the ration. Since Balch (1958) has shown a three fold increase in saliva secretion during mastication of the same weight of hay as compared to concentrates. In general, rumen pH was consistently higher in animals on roughage than on concentrate diet (Rumsey *et al.*, 1970).

The concentration of ammonia in the rumen fluid was also decreased with increased level of date stones in the ration and the maximum daily mean concentration (mg/100ml) was observed at 0% date stones. Differences among treatments were highly significant ($p < 0.01$). Low pH of the rumen fluid was accompanied by a parallel depression in the ammonia-nitrogen content (Table 4). As it was previously suggested that the decrease in ruminal pH probably reflects changes in saliva flow since salivation is expected to be reduced by increasing date stone content in the ration, and consequently may alter the flow of the endogenous secretions in the rumen. Studies of the duodinal flow of nitrogen in sheep given a wide variety of forage foods (Hogan and Weston, 1969), have revealed that there is net incorporation of endogenous nitrogen during rumen digestion when the nitrogen content of the diet is less than 4% of the dietary digestible organic matter. The diet used in the present investigation I would fall below the 4% margin suggested by Hogan and Weston (1969) and consequently the synthesis of microbial mass would depend on the supply of endogenous nitrogen.

The mean daily concentration of VFAs had a maximum value with rations containing no date stones, then decreased significantly ($p < 0.05$) as the percent of date stones increased in the ration (Table 4). Raun *et al.* (1962) and Judson *et al.* (1968) reported similar results using mixed roughage and concentrate diets. In contrast, a greater concentration of VFAs existed in the reticulo-rumen ingesta of animals fed relatively high concentrate diet than when fed coarse roughage (Balch, 1960 and Moore, 1964).

The values of molar percentages of the individual VFAs revealed a steady decrease in the proportion of acetic acid in the rumen, whereas, propionic, butyric, isovaleric and valeric acids were increased as the proportion of date stones in the ration increased (Table 4). Similarly, the majority of hays examined have given high values for the proportion of acetic acid and particularly low values for butyric acid (Rook, 1964). Increased propionate levels at the expense of acetate are generally associated with high concentrate ration (Weiss *et al.*, 1966). Differences among treatments concerning acetic, propionic and isovaleric acids were significant.

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OPTIMUM AGE FOR FATTENTING AWASSI LAMBS[1]

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SUMMARY

Forty five Awassi male lambs were used in the present study and were fattened either at 5, 7, 9 or 11 months old. The fattening and pre-fattening rations were composed of mixed concentrates plus roughages. While the roughages were introduced ad libitum, the concentrates were introduced either at ½% during the pre-fattening period or 2% of the average livebody weight of the average livebody weight of the animals during the fattening period. All lambs were killed at 50 Kg body weight and carcase traits were studied.

Age at fattening affected significantly initial weight, total gain and daily gain. Efficiency of feed conversion was found to be 5.98, 5.75, 6.69 and 6.24 Kg TDN/Kg gain for lambs fattened at 5, 7, 9 and 11 months old, respectively, showing those fattened at earlier age to be more efficient than those fattened at latter stages in converting food to livebody gain.

Treatment had no significant effect on slaughter weight, empty body weight, hot carcass weight, dressing percentage, chilled carcass weight and the percentage of shoulder, flank and tail. While it affected significantly the percentages of neck, loin and legs.

It was concluded that the optimum age at fattening for Awassi lambs yould depend on the availability and price of the concentrates. If the

1. Part of M.S. thesis submitted by the senior author.

concentrates are available at a relatively lower price, fattening should start at earlier age, possibly at 5—7 months old. If, however, concentrates are not available or relatively expensive then fattening may be started at latter age i.e. 11 months old.

الخلاصـــة

استعمل في هذه التجربة ٤٥ حمل عواسي ذكور وقسمت الى اربع مجاميع حيث سمنت عند اعمار ٥ ، ٧ ، ٩ و ١١ شهرا · تكونت عليقة ما قبل التسمين وكذلك عليقة التسمين من مخلوط مركز بالاضافة الى مادة مالئة خضراء · قدمت المادة المالئة في كلا الفترتين حتى الشبع في حين قدمت المادة المركزة في حداد ½٪ أو ٢٪ من متوسط وزن الحيوانات في فترة ما قبل التسمين وفترة التسمين عـــلى التوالي · ذبحت جميع الحيوانات عندما وصلت الى وزن ٥٠ كغم ودرســـت صفات اللشة ·

العمر عند التسمين اثر تأثيرا معنويا على الوزن الابتدائي والزيادة الكليـة والزيادة اليومية في وزن الحيوانات · تأثرت كفاءة تحويل الغذاء بالمعاملة وكانت ٩٨ر٥ ، ٧٥ر٥ ، ٦٩ر٦ و ٢٤ر٦ كغم مادة كلية مهضومة لكل كغم زيادة في وزن الحيوانات مما يدل على ان كفاءة تحويل الغذاء كانت جيدة عندما بدء التسمين باعمار صغيرة بالمقارنة بالاعمار الكبيرة ·

لم تؤثر المعاملة تأثيرا معنويا على الوزن النهائي ، الوزن الفارغ ، وزن اللشة قبل التبريد او بعد التبريد ، نسبة التصافي وكذلك نسب كل من الاكتاف ولحم البطن والذيل في حين اثرت تأثيرا معنويـا على نسب كل من الرقبة ومنطقة الضلوع والقطن والارجل ·

استخلص من هذا البحث انه يجب تسمين الحملان في اعمار صغـــيرة (٥ـ٧ شهور) اذا كانت العليقة المركزة متوفرة وذات سعر رخيص نسبيا في حين يجب تسمين تلك الحملان في اعمار متأخرة (١١ شهرا) اذا كانت العليقة المركزة غير متوفرة او ذات سعر مرتفع نسبيا ·

INTRODUCTION

Under the condition of central Iraq, lambing occurs during November and December. Consequently, lambs are usually weaned during March and April and male lambs are killed for human consumption between weaning and one year of age. Slaughtering is usually governed by demand rather than a fixed system for producing fat lambs. Therefore, lambs are slaughtered under a wide range of age, livebody weight and fattening condition. Thus, initiating a system for fattening such lambs seems to be of special importance.

The present study was designed to investigate the optimum age for fattening Awassi lambs.

MATERIALS AND DETHODS

Experimental animals:

Fourty five, Awassi male lambs 5 months old with an average body weight of 17.98 Kg, were available for this study. These lambs were born and reared at the Animal Production Experimental Station in Abu-Ghraib, Ministry of Agriculture.

Treatments:

The lambs were transferred to the College of Agriculture Experimental Farm in Al-Ameria, University of Baghdad, and were kept together in one shed up to the age of 5 months. At this age lambs were randomly divided into 4 experimental groups. Group I was put on the fattening ration when their average age was 153 days (System I). The rest of the animals were kept as one group on a pre-fattening ration. The fattening started at the age of 7, 9 and 11 months for groups II (System II), III (System III) and IV (System IV) respectively. Lambs of the different treatment groups were fattened separately.

The fattening ration consisted of concentrates and roughage. Concent-

rates were offered at the rate of 2% of the average livebody weight, while roughages were offered ad libtum. The pre-fattening ration consisted of the same feeding stuffs, however, the concentrates were fed at the rate of ½% of the average livebody weight. Concentrates consisted of 60% ground barley, 22% wheat bran, 15% sunflower meal, 2% limestone and 1% common salts, with estimated total digestible nutrients (TDN) of 67.7% and digestible crude protein (DCP) of 12.53%. Alfalfa or green barely were used as roughages. Mineral blocks and free water were available all time. Food was introduced twice daily. Feed refusals were recorded. Periodical samples of feeding stuffs offered were taken for dry matter determination. Lambs were weighed at the start of the experiment and at weekly intervals thereafter.

Carcass studies:

At the end of the fattening period (average livebody weight of 50 Kg) lambs of each group were slaughtered. Slaughter weight, empty body weight, hot carcass weight and the weight of different offals and organs were recorded after slaughtering and dressing. Empty body weight was obtained by substracting the weight of the digestive tract contents from the livebody weight according to Everitt and Jury (1966). The carcasses were chilled for 48 hrs, after such period they were cut into wholesale cuts as described by Younis *et al.* (1975). The longissimus dorsi muscle area was measured in cross-section between the 11th and 12th ribs (Henderson *et al.*, 1966), and the physical components of the 9-10-11 rib cut were determined i.e. lean, fat and bone.

Statistical analysis:

The results were statistically analysed using analysis of variance and covariance (Snedecor and Cochran, 1971). Duncan's Multiple Range Test (DMRT) was used to detect significance among different means.

RESULTS AND DISCUSSION

Feed intake:

Estimated daily TDN intake per animal was found to be 830, 880, 920 and 980 g for systems I, II, III and IV respectively. These values are somewhat lower than those reported by the NRC (1972) for sheep of the same live weight. The percentage of dry matter intake to livebody weight ranged from 3.6 for those fattened at 11 months to 4.2 for those fattened at 7 months old. The proportion of concentrates in the rations ranged from 49.6 to 57.7% among different treatment groups.

Livebody gain and efficiency of feed conversion:

The fattening performance of lambs in different groups is summarised in Table 1. Initial body weight differed among different treatment groups and this was mainly due to differences in age at the start of fattening. However, average slaughter weight for different treatment groups was very close to the aimed figure (50 Kg).

Total gain, daily gain and fattening period differed significantly ($P < 0.5$) among treatment groups (Table 1). The average age as slaughter was found to be 377, 413, 425 and 414 days for those fattened at 5, 7, 9 and 11 months, respectively, showing the superiority of those started at 5 months old (System I) as compared to the rest of the groups. The highest daily agin was scored by lambs fattened at 11 months old (156.7 g), followed by those fattened at 7 (154.7 g), 5 (138.9 g) and 9 (134.9 g) months, in this order. Farhan *et al.* (1969) reported a daily gain of 141.9 g for Awassi lambs.

Lambs in systems I, II, III, and IV, consumed, respectively 5.98, 5.75, 6.69 and 6.24 Kg TDN to produce one Kg of body gain. An attempt was made to study the change of efficiency of feed conversion (EFC) with the advancement in the fattening period. Thus, EFC was calculated during the period from 5-7, 7-9, 9-11 months of age. The lambs were more efficient during the period from 5 to 9 months of age than during the period from 9 to 11 months old. Such pattern could be explained partly by differences in growth curve and differential growth of different tissues of such animals.

TABLE 1. Feed intake, total gain and efficiency of feed conversion for lambs in different treatment groups.

Item	Systems of fattening			
	I	II	III	IV
No. of lambs	11	11	12	11
Initial weight, Kg.	18.31a	18.91a	28.83b	37.21c
Final weight, Kg.	49.90a	50.10a	49.80a	49.90a
Total gain, Kg.	31.59a	31.19ab	20.97c	12.69d
Fattening period, day	227	202	153	81
Age at slaughter, day	377	413	425	414
Daily gain, g.	138.9a	154.7bd	134.9ac	156.7d
Average D M intake, Kg/day	1.345	1.441	1.449	1.554
Average D M intake/100 Kg body wt.	3.94	4.18	3.69	3.56
Average T D N intake, Kg/day	0.830	0.880	0.920	0.980
Kg T D N intake/Kg gain	5.98	5.75	6.69	6.24

Means on the same line not followed by a letter in common differ significantly ($P < 0.05$).

Younis *et al.* (1976) found that efficiency of feed conversion to depress with the advancement of age of lambs during fattening. On the other hand, the 9-11 months of age for the experimental animals coincided with the period from 29th July to 29th September, which is considered the hottest period of the year. This type of environment may be partly responsible for such depressed EFC obtained in the present study.

For proper comparison of different systems used for fattening, the performance of the lambs in different groups during the pre-fattening period was considered. Taking both the pre-fattening and fattening periods into account, lambs fattened at 7 months were the most efficient ones followed by those fattened at 5, 11, and 9 months, respectively. However, difference in EFC was aimost negligible between those fattened at either 5 or 7 months old. On the other hand, lambs fattened at 5 months of age consumed relatively higher amount of concentrates than those fattened at 7 months old. The consumption of roughages was in the opposite direction. Thus, the selection of the system of fattening would depend on many factors, among which is the availability of both roughages and concentrates and their relative prices.

Carcase data:

Empty body weight (EBW) was not affected by treatment (Table 2). However, dressing percentage based on EBW was found to decrease, though not significantly, with the advancement of age at fattening. The values being 49.8, 49.0, 48.3 and 46.7% for lambs fattened at 5, 7, 9 and 11 months of age, respectively. Such results indicate that age has no apparent effect on dressing percent. Age is expected to affect dressing percentage through its effect on livebody weight, and since average slaughter weight for different lambs in different systems was almost similar, regardless of their age, one can not expect that treatment would affect dressing percentage.

Differences in chilled carcass weight were not statistically significant. Treatment significantly affected the percentage of neck, rack, loin and legs

TABLE 2. Carcass triats of lambs fattened on different systems of fattening.

Item	Systems of fattening			
	I	II	III	IV
No. of lambs	11	11	12	11
Slaughter weight, Kg.	49.90	50.10	49.80	49.90
Empty body weight, Kg.	43.84	44.84	45.34	44.78
Hot carcass weight, Kg.	19.33	19.69	19.64	19.04
Dressing percentage[1]	42.40	43.40	44.20	41.70
Dressing percentage[2]	49.80	49.00	48.30	46.70
Chilled carcass weight, Kg.	18.83	19.01	18.73	18.20
Wholsale cuts[3]				
Neck	9.10a	6.75bc	6.25c	7.40b
Shoulder	17.63	17.80	17.45	17.30
Rack	25.60a	28.90b	32.05c	29.40a
Loin	8.70a	9.10a	6.70b	6.40b
Flank	6.45	7.10	6.40	6.50
Legs	31.85ab	30.72a	32.15ab	33.10b
Tail	3.70	4.30	4.60	3.90

1. Based on slaughter weight.
2. Based on empty body weight.
3. As a percentage of chilled carcass weight.

Means on the same line not followed by a letter in common differ significantly ($P < 0.05$).

(Table 2), while had no effect on the percentage of flank and tail.

The percentage of prime cuts (shoulder, rack, loin and legs) were found to be 84, 86.5, 88.4 and 86.2 for lambs fattened at 5, 7, 9 and 11 months of age, respectively, with no consistent trend. Ray and Kromann (1971) found that lambs of 180 days of age yielded highest percentage of retail cuts compared with lambs at 150 and 120 days.

The physical composition of the 9-10-11 rib cut represents the lean, fat and bone content of the carcass (Kirton and Barton, 1962). In the present study treatment did not affect significantly the composition of this cut and this may be due to the fact that all lambs were slaughtered almost at the same livebody weight (Table 3). Mean time values of lean percentage are in accordance with those obtained by Farhan *et al.* (1969) on the same breed.

Eye muscle area per Kg of chilled carcass weight was found to be 0.65, 0.67, 0.64 and 0.65 Cm^2, with differences being not significant. Likewise, fat thickness over the longissimus dorsi muscle did not differ significantly among treatment groups, however, lambs of treatment II had the higher value which is in accordance with the results of the 9-10-11 rib cut physical composition.

TABLE 3. Physical composition of the 9-10-11 rib cut, eye muscle area and fat thickness over L. dorsi for lambs in different treatments.

	Systems of fattening			
	I	II	III	IV
Lean %	49.30	50.72	48.90	51.70
Fat %	28.80	30.00	27.10	26.30
Bone %	21.80	19.30	23.80	21.90
Eye muscle area/Kg chilled carcass weight, cm^2	0.65	0.67	0.64	0.65
Fat thickness over L. dorsi, mm.	3.96	5.61	4.23	4.63

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THE EFFECT OF DIFFERENT TREATMENTS ON SOME BACTERIOLOGICAL AND CHEMICAL ASPECTS OF FOUR TYPES OF POULTRY WASTE IN IRAQ*

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SUMMARY

A study was carried out to determine the feasibility of poultry dropping as a feedstuff. Bacteriological and chemical analyses of 1) Broiler litters, two and eight weeks old, 2) Parent stock (Studler) litters, fifty two weeks old, and 3) Dropping from beneath caged layers (Tatra-L), were studied.

Each type of the dropping was treated by one of the following methods: 1) Autoclaving, 2) Tyndallization, 3) Sun-drying, and 4) Unprocessed (Control).

The highest number of bacteria found was that of spore forming aerobes, Gram-positive bacilli.

The bacterial count in 8-week old broiler litter was greater than that found in 2-week old litter. The most predominant types of bacteria were the *Staphylococcus* aureus. The number of bacteria was decreased after drying in the sun.

* Part of M.S. thesis submitted by the senior author .

The highest bacterial count of dry litters of parent stock at 52-weeks old was shown by lactose-fermenting Gram-negative types.

The same results were also true in the case of droppings from beneath caged layers.

Sterilization by autoclaving and tyndallization showed no microbial growth after sample culturing.

A highly significant difference was observed in moisture, crude fiber, crude protein, ether extract, ash, phosphorus and potassium contents between the different types of droppings.

الخلاصـــــة

اجريت التحاليل الكيمياوية والبكتريولوجية لاربعة انواع من فضـــلات الدجاج :

١ ـ فضلات فروج اللحم بعمر اسبوعين ·
٢ ـ فضلات نفس فروج اللحم ولكن بعد عمر ثمانية اسابيع ·
٣ ـ فضلات أمهات فروج اللحم بعمر (٥٢) اسبوع ·
٤ ـ فضلات الدجاج البيوض المبرز توا ·

لقد تم تحليل (٣٠) نموذجا من كل من أنواع الفضلات المذكورة اعلاه والتي حصلنا عليها من حقول الشركة العامة للدواجن في المرادية التابعة لوزارة الزراعة والاصلاح الزراعي ·

لقد عوملت الفضلات المستعملة في التحليل باحدى الطرق التالية :ـ

١ ـ التعقيم بواسطة بخار الماء المضغوط (استعمال جهاز الـ Autoclave) ·
٢ ـ التعقيم بواسطة بخار الماء الحار وبفترات متقطعة ·
٣ ـ التعريض لاشعة الشمس لمدة ١٠ أيام ·
٤ ـ ترك النموذج الرابع دون معاملة لغرض المقارنة ·

اعتمد في طرق التحليل البكتريولوجي اتباع الطرق القياسية العالمية لمعرفة المدد الكلي للبكتريا المحتمل وجودها في ١غم من الفضلات وكذلك معرفة عدد البكتريا

المسببة للامراض والمحتمل وجودها في مثل هذه الفضلات • اما من الناحيـــة الكيمياوية فقد تركزت الدراسة على معرفة بعض محتويات هذه الفضلات مـــن العناصر الغذائية والتى لها اهمية في تغذية الدواجن •

لقد دلت النتائج للتحليلات البكتريولوجية ان هناك اختلافا كبيرا بما تحويه الفضلات المختلفة من البكتريا كميا ونوعيا وكذلك هناك اختلافا بين كمية البكتريا ونوعيتها في نموذج واحد عومل بالمعاملات المختلفة • فقد وجد ان انواع كثيرة من سبورات العفن والخمائر موجودة في فضلات فروج اللحم لعمر اسبوعين وليست موجودة في نفس الاعداد أو الانواع بالنسبة الى الفضلات لنفس الفروج بعمـــر ٨ أسابيع ، كذلك وجدت ثلاثة حالات من فضلات الدجاج البيوض التى تدل دلالة واضحا بأنها بكتريا تيفوئيد الدجاج ولكن مثل هذه الحالة لم تلاحظ في باقى انواع الفضلات التى حللت بكتريولوجيا •

اما من الناحية الكيمياوية فقد دلت الدراسة وبعد تحليل النتائج احصائيا ان هناك فروق احصائية مهمة في نسبة الرطوبة والطريقة التى عوملت بها الفضلات • وكذلك وجدت فروق احصائية مهمة في كمية الالياف ، البروتين الخام ، نسبة المواد الدهنية ومقدار الطاقة الحرارية ما بين الانواع المختلفة متأثرة بطرق المعاملة المستعملة في هذا البحث •

INTRODUCTION

The chemical analyses of poultry droppings indicate that such droppings contain available nutrients for poultry rations namely protein (Lee and Blair, 1973), minerals (Hileman, 1971), and energy (Shannon *et al.* 1973). Feeding trials have established the value and limitations of manure as feeds (Quisenberry and Bradley, 1969). If this cheap material is used in some way in poultry rations, the cost of the ration will be reduced, and consequently production cost is lowered.

Many approaches have been investigated for disposing of the massive quantities of manure produced by livestock and poultry. One approach is to recycle the manure through the same or other species of animals to utilize the available nutrients.

Many investigators have suggested various methods for processing the dropping prior their use in rations for cattle, sheep and poultry (Noland *et al.* 1955; Fontenot *et al.* 1966; Flegal and Zindel, 1971; Lee and Blair, 1972 and Shannon *et al.* 1973).

In this work some of the chemical and bacteriological aspects of poultry droppings were studied, and the results would assist in the development of a manure sterilization method that warrants the destruction of pathogenic organisms.

Bacteriological Aspects:

The presence of bacteria in the litter can be specifically detected by determining enteric bacteria which makes up a significant part of the solid animal wastes. These "indicator" becteria, the total coliform, and faecal streptococci, in addition to those of enteric anaerobic types and those pathogenic organisms are detected by standard bacteriological methods which are described by American Public Health Association (1971).

Kern (1897) reported that 60—65 percent of the total population of microflora in the chick intestines are coliforms. This is in agreement with those reported by Bogdonoff *et al.* (1959) and Barenes and Impey (1970).

Klein and Casida (1967) showed that *Esherichia coli* and *Salmonella* died rapidly when deposited on a feedlot under aerobic conditions, but *Salmonella* survived under anaerobic conditions. This is in agreement with the results reported by McCalla and Elliott (1971).

Strauch and Mueller (1968) noted that fresh manure from caged layers rapidly undergoes a process of autosterilization with respect to *Salmonella*. A qualitative test done by Kraft *et al.* (1969) for *Salmonella* on composited samples of freshy voided excreta showed that 29 percent were positive. However, Hillstrom and Busse (1971) stated that poultry litter became negative for *Salmonella* at the end of a seven day ensiling period.

Chemical Analysis:

Jaeger (1973) reported that 20,000 brown egg laying hens produced 3 tons of droppings per day containing 78 percent moisture. This is in agreement with the figure calculated (74%) by Stewart and McIlwain (1971). In other report, Scholz (1971) stated that the moisture content of chichen manure upon excretion is about 75 percent. While broiler litter contains only about 28.86 pecent moisture (Patrick, 1967).

Galler and Davey (1971) stated that the pH of poultry manure mixed with sawdust in the batch varied from 5.4 to 7.0 and this will change to 8.9—9.0 to bacterial decomposition of the manure. In another report by Bressler and Bergman (1971) the pH of dry manure with 10 percent moisture was around 7.0. While Stewart and McIlwain (1971) indicated that the pH of manure under cages ranged from 6.5 to 9.0 and the majority of readings were between 7.0 and 8.0.

Hileman (1971) found that the litter from broilers contained 4.11% nitrogen, 1.45% phosphorus and 2.18% potassium. Whereas dry poultry manure contained 5.6% calcium and 1.8% phosphorus, half of which was available for chicks (Shannon *et al.*, 1973).

In 1970 Benne showed that total protein was reduced in the dried manure as compared with the fresh manure. This was probably due to the high temperature during drying. He found that chicken manure containing 5—15% moisture stored for two years showed no signs of deterioration. Using an air current drier for 4 hours, protein contents were reduced 25% as the temperature increased from 80 to 500°C. An inverse relationship between drying temperature and total protein was recorded by Surbrook *et al.* (1971). On the other hand, Fontenot *et al.* (1971) reported that poultry manure containing 42.29% crude protein displayed a reduction in its crude protein to 41.60% when autoclaved at 116°C under steam pressure of 1.06 Kg sg cm for 30 to 129 min and this decreased to 35.35% at 100°C hot air oven.

Bucholtz *et al.* (1971) stated that dehyrated caged layer waste contained various percentages of protein ranging from 17—25%. Hodgetts (1971) noted that dry poultry manure with 10% moisture contained 32.60% crude protein. But Lee and Blair (1973) found that manure from layer battery to have 22.4% crude protein.

Surbrook *et al.* (1971) reported that caged layers' fresh manure contained around 3% ether extract whereas that dried at 500°C contained 2.8%. Bull and Reid (1971) estimated the percentage of ether extract of air dried caged chicken manure as 1.43%. But Hodgetts (1971) found that if manure from caged brown egg hybrid pullets, 18 weeks old, was dried and granulated to contain 12—18% moisture, it contained 1.75% ether extract, and in the case of untreated manure it was 2.74%.

Fresh poultry manure collected from cages was reported to contain 17.16% crude fiber (Flegal and Zindel, 1970). But Bucholtz *et al.* (1971) found dehydrated caged layer waste to contain 16.6% crude fiber. While Hodgetts (1971) reported that dry manure from caged brown egg hybrid pullets with 12—18% moisture contained 11.90% crude fiber on dry matter basis. In other report. Fontenot *et al.* (1971) concluded that processed litter did not differ significantly ($p < 0.05$) from unprocessed litter.

Pryor and Connor (1964) found that poultry waste had a metabolic energy value of caged manure of about 500 cal/lb. Bull and Reid (1971) showed that air-dried poultry manure contained 3298 K cal/Kg as gross energy. Shannon *et al.* (1973) found that metabolic energy values of the cage manure varied from 0.67—1.27 K cal/g. Also they found that autoclaving did not significantly affect the metabolic value.

MATERIALS AND METHODS

Four types of poultry droppings, namely: a) Broiler litters, two and

eight weeks old, b) Parent stock (Studler)* litters, fifty two weeks old, and c) Droppings from beneath caged layers (Tatra-L),** were collected from Muradia General Poultry Company Farm, Ministry of Agriculture and Agrarian Reform.

A total of thirty samples from each of the four types of manure were collected at random from 20 places. The samples were transfered into Cryovac (Polyvinylidene Chloride Copolymer) containers using sterile spatulas.

Each sample was divided into two parts; one was utilised immediately for bacteriological analyses, the other was dried at 50°C for 24 hrs, ground to pass through a one mm mesh, and divided into four lots. One lot was autoclaved at 118°C and a pressure of 15 lbs/in²/one hour (2.3 Kg/Cm²) to sterilize 0.25 Kg, or 3 hrs if the quantity of the sample was 20 kg. The second lot underwent Tyndallization of fractional sterilization as described by Tyndall (1877), one quarter Kilogran of poultry droppings was treated for one hour a day in a steam sterilizer for 5 consecutive days, or three hours daily if the quantity of the sample to be steriled was twenty Kilograms. The third lot was sundried by spreading 5 cm layer of the manure in an open area for 10 days (June 10—20) with approximate temperature of 40—48°C. The fourth lot was used as a control.

A) Bacteriological analysis:

Isolation procedures of bacteria from the four types of poultry waste included:

1. Total count was facilitated by Standard plate count (SPC) procedures (American Public Health Association, 1971), using plate count nutrient agar (Oxoid),* with dilutions ranging from 1:10 to $1:1X10^{-14}$ using Ringer's

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* S.a. Studler: 2, rue A. Rousseau B.P. 160—29210 MORLAIX-France.

** Tatra-L: Tatum Farms Route 3, Dawsonville, Georgia 30534 U.S.A.

* The Oxoid Division of Oxo Ltd., London E. C. 4, England.

solution (Quarter Strength, BDH)*.

2. Differential count to investigate:

a. Pathogenic Staphylococci by using the Mannitol salt agar media (Oxoid), followed by Staphylococcus medium 110 (Difco 1969).**

b. Salmonella species, using Salmonella-Shigella agar (Difco, 1969).

c. Coliform groups, using MacConkey bile salt media as well as Eosine-Methylene blue media (Oxoid).

d. Aerobic spore forming bacteria, using the Nutrient agar (Oxoid).

e. Anaerobic spore forming bacteria, using the McIntosh and Fildes's (1916) anaerobic Jar with a freshly made Thioglycollate media (Brewer, 1940).

f. Molds and yeasts, using the Sabouroud dextrose agar (Oxoid).

The isolates were indentified by standard biochemical and serological typing methods as well as by microscopical examination using the Hucker modification of the Gram's staining procedure (Committee on Bacteriological Technic, 1957).

B) Chemical analysis:

The methods employed here for proximate analyses were adopted from AOAC (1970). Hydrogen-ion concentration determination was facilitated by a Beckman Zeromatic pH-meter. Calcium percentage was determined using the volumetric procedure. Phosphorus content was determined by the Vanadomoloybdate method, using a photoelectric Colorimeter or Spectronic 20, Bauch and Lomb. Potassium percentage was determined by means of the Perkin-Elmer, model 52 flame photometer. Heat of combustion (gross energy) was determined by adiabatic Oxygen Bomb Calorimetry (Fisher Scientific Ltd. 1964).

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* The British Drug Houses Ltd., B.D.H. laboratory Chemicals Division Pool. England.

** Difco laboratories, Detroit I, Michigan U.S.A.

The data from the experiment were subjected to statistical analysis. The most common analysis used was the analysis of variance as outlined by Snedecor and Cochran (1967). If the F value was significant, the standard error of the means was then calculated and Duncan's (1955) multiple range test was employed.

RESULTS AND DISCUSSION

Bacteriological quality:

Sterilization of litter and manure by autoclaving and tyndallization showed no microbial growth after examination. The results of the bacteriological examination are given in Table 1. The number of microorganisms in the samples was not affected by sun-drying.

The litter of parent stock (52 weeks old) showed a higher number of microorganisms (10 X 10^9) as compared to the other types of wastes. This was expected due to age. Perhaps one of the potentially more hazardous features of including dry poultry waste in poultry diets is the risk of spreading disease. The disease hazard may well be reduced when the dry poultry waste is produced and recycled on the same farm (Alexander *et al.* 1968).

Chemical analysis:

The results of proximate analysis for the different types of poultry waste used in this work are shown in Table 2.

A highly significant ($P < 0.01$) difference between the types of the waste, namely moisture, crude fiber, crude protein and ether extract was found. They also differed significantly according to ash, calcium, phosphorus and potassium, (Table 3.).

Treatment had less effect ($P < 0.05$) on moisture and ash, and none on crude fiber, crude protein, ether extract, calcium, phosphorus and potassium contents.

Broiler litter at two week old differed significantly ($P < 0.01$) from the other three types in regard to pH value. Similarly, sun-dried droppings differed

TABLE 1. Differential and total counts of microflora/g of poultry wastes.

Types of Microorganisms	Broiler litter, 2 wks. old		Broiler litter, 8 wks. old		Parent Stock, 52 wks. old litter		Caged Layers Manure	
	Unprocessed Litter	Sun-dried (10 days at 28—32°C) Litter	Unprocessed Litter	Sun-dried (10 days at 28—36°C) Litter	Unprocessed Litter	Sun-dried (10 days at 25—40°C) Litter	Unprocessed Fresh	Sun-dried (10 days at 40—58°C) Manure
Staphylococcus aureus	2.7×10^5	2.3×10^4	3.9×10^6	5.0×10^6	2.0×10^7	1.4×10^5	2.9×10^6	2.9×10^6
Spore-forming (aerobes)	U	2.6×10^5	2.6×10^4	7.7×10^4	N	3.3×10^5	1.7×10^5	2.3×10^3
Spore-forming (anaerobes)	1.1×10^5	2.4×10^4	3.5×10^5	3.1×10^5	N	N	3.0×10^6	2.9×10^6
Lactose non-ferment (g-ve) bacilli	N	N	N	N	N	N	N*	N
Lactose ferment (g-ve) bacilli	1.7×10^3	8.6×10^3	1.5×10^5	11.5×10^4	3.1×10^7	2.9×10^6	3.1×10^7	2.2×10^6
Molds	+	+	−	+	+	+	+	+
Yeasts	+	+	+	−	+	+	−	−
Total connt (SPC)	13.1×10^7	16.8×10^6	6.5×10^8	2.5×10^8	10.0×10^9	7.2×10^8	3.6×10^{10}	6.2×10^{10}

U = Uncounted colonies at dilution 10^{-6} (more than 300 colonies/plate).

N = None or no growth (less than 30 colonies/plate).

\+ = Positive growth.

− = No growth.

* = Three samples of thirty present.

TABLE 2. Chemical composition of different chicken manure.

Types of litter	Broiler Litter, 2wks. old				Broiler Litter, 8 wks. old				Parent Stock Litter, 52 wks. old				C
Methods of processing	Unprocessed	Sun-dried	Auto-claved	Inter-mittent steaming	Unprocessed	Sun-dried	Auto-claved	Inter-mittent steaming	Unprocessed	Sun-dried	Auto-claved	Inter-mittent steaming	Unprocessed
Moisture	16.37	8.28	12.86	16.14	19.58	10.48	20.40	24.60	22.95	12.57	24.93	25.02	70.94
Crude fiber	41.54	48.29	39.83	37.96	12.54	16.17	12.69	14.01	14.75	18.32	17.31	16.56	10.10
Ash	9.45	9.25	9.00	8.91	14.01	17.00	14.05	15.31	18.64	19.77	18.62	18.42	9.91
Crude protein	9.57	9.26	9.52	9.54	21.91	20.93	18.63	22.01	19.57	15.08	17.63	17.40	20.97
Ether extract	2.47	2.33	2.13	2.12	1.53	1.58	2.23	1.95	0.77	0.27	0.56	1.28	3.23
Gross energy Kcal/Kg	2750	2660	2600	2535	3230	3223	3246.	3223	2400	2373	2387	2468	2700
Calcium	5.26	6.50	5.20	5.24	5.26	5.78	5.21	4.72	4.83	4.76	5.17	5.17	12.28
Phosphorus	1.60	1.91	1.86	2.10	1.54	2.35	1.57	1.55	3.29	3.10	3.26	3.33	3.81
Potassium	1.34	1.43	1.04	1.03	2.04	2.40	2.95	2.22	2.30	2.30	2.33	2.40	2.04
pH	6.76	5.26	6.74	6.74	8.00	7.71	7.83	7.82	7.72	5.60	7.11	7.10	7.80

TABLE 1. Differential and total counts of microflora/g of poultry wastes.

Types of Microorganisms	Broiler litter, 2 wks. old		Broiler litter, 8 wks. old		Parent Stock, 52 wks. old litter		Caged Layers Manure	
	Unprocessed Litter	Sun-dried (10 days at 28—32°C) Litter	Unprocessed Litter	Sun-dried (10 days at 28—36°C) Litter	Unprocessed Litter	Sun-dried (10 days at 25—40°C) Litter	Unprocessed Fresh	Sun-dried (10 days at 40—58°C) Manure
Staphylococcus aureus	2.7×10^5	2.3×10^4	3.9×10^6	5.0×10^6	2.0×10^7	1.4×10^5	2.9×10^6	2.9×10^6
Spore-forming (aerobes)	U	2.6×10^5	2.6×10^4	7.7×10^4	N	3.3×10^5	1.7×10^5	2.3×10^5
Spore-forming (anaerobes)	1.1×10^5	2.4×10^4	3.5×10^5	3.1×10^5	N	N	3.0×10^6	2.9×10^6
Lactose non-ferment (g-ve) bacilli	N	N	N	N	N	N	N*	N
Lactose ferment (g-ve) bacilli	1.7×10^3	8.6×10^3	1.5×10^5	11.5×10^4	3.1×10^7	2.9×10^6	3.1×10^7	2.2×10^6
Molds	+	+	−	+	+	+	+	+
Yeasts	+	+	+	−	+	+	−	−
Total connt (SPC)	13.1×10^7	16.8×10^6	6.5×10^8	2.5×10^8	10.0×10^9	7.2×10^8	3.6×10^{10}	6.2×10^{10}

U = Uncounted colonies at dilution 10^{-5} (more than 300 colonies/plate).

N = None or no growth (less than 30 colonies/plate).

\+ = Positive growth.

− = No growth.

* = Three samples of thirty present.

TABLE 3. Analysis of variance for the effect of treatments and types of poultry waste on moisture, crude fiber, crude protein, ether extract, ash, Ca, P, K, gross energy contents and pH value.

Source of Variation	D.F.	M. S.									
		Moisture	C. Fiber	C. protein	E. extract	Ash	Ca	P	K	G. energy	pH
Types	3	1556.8**	830.7**	124.8**	2.3**	75.3**	50.4*	3.9**	1.2**	495848.0**	1.6**
Treatments	3	363.0*	14.1	1.9	0.2	2.3*	0.2	0.0	0.0	8170.0	1.5
Errors	9	87.1	3.9	1.6	0.2	0.5	11.3	0.1	0.1	9219.0	0.1

* Significant at level $P < 0.05$.

** Significant at level $P < 0.01$.

significantly ($P < 0.01$) from the other three treatments. These results are in agreement with those of Galler and Davey (1971).

The effect of treatment on the gross energy contents was not significant (Table 3). Whereas, eight week broiler litter had a significantly ($P < 0.01$) higher value than other types. Such results confirm those obtained by Bull and Reid (1971).

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TESTICULAR CHANGES IN RAHMANI RAMS FOLLOWING PROLONGED ADMINISTRATION OF STILBESTROL DIPROPIONATE

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ABSTRACT

Stilbestrol dipropionate was administered to yearling Rahmani rams for a period of 90 days at the rate of 3 mg per animal per day. There was a significant decrease in the weight of testes. Histological examination of the testes revealed a predominance of seminiferous tubules that were reduced in diameter and lined principally by spermatogonial cells and vacuolated Sertoli's cells. Spermatogenesis was inhibited. Intra luminal aggregates of exfoliated germ cells were observed in the seminiferous tubules. Normal Leydig cells were absent.

الخلاصـــة

اجريت هذه الدراسة بغرض معرفة تأثير اعطاء مادة الاستلبستيرول لمدة ثلاثة اشهر على التغيرات التى تطرأ في الخصية في الاغنام الرحماني ٠

وقد اعطى الاستلبستيرول عن طريق الحقن على فترات اسبوعية بجرعات تشكل ٣ ملغم في اليوم لكل حيوان ٠

ظهرت تغيرات هستولوجية واضحة في الخصية في مجموعة الحيوانات التى

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اعطيت الاستلبستيرول حيث توقف انتاج الحيوانات المنوية تماما ، كما لوحظ انسلاخ معظم الخلايا الجنسية داخل الانابيب المنوية ما عدا الخلايا الجنسية الاولية Spermatogonia cells التى وجدت تبطن معظم الانابيب المنوية • كما لوحظ تغير واضح في شكل الخلايا البينية التى تشير الى فقدان كثير من وظائفهـا الفسيولوجية •

INTRODUCTION

Stilbestrol has been widely used in finishing livestock in order to improve rate of gain, feed conversion and meat quality. Estrogen administration has been reported to cause a depression in semen quality in bulls (Ocasa *et al.*, 1962), rams (Moule and Mattner, 1961), goats (Roy, 1960) and rats (Mori, 1952). The extent of the damage induced in the testes depends on the dose and frequency of the estrogen administration. Moule and Mattner (1961) reported that the dose required to produce seminal degeneration was much lower in sheep than in cattle. Recovery of the semen, the estrogen administration was completely ceased, occured in bulls within 3 weeks to 6 months (Ocasa *et al.*, 1962 and Cupps *et al.* 1960), in rams within 6—9 weeks (Moule and Mattner, 1961) and in dogs within 5—6 months (Brouwers *et al.*, 1956).

The present study was undertaken to study the histological changes in the testes of young Rahmoni rams after 90 days administration of stilbestrol dipropionate.

MATERIALS AND METHODS

Six native Rahmani rams, 10 months old, weighing on average 37 Kg were used. Each animal was fed a daily ration composed of 3/4 Kg concentrates and 1/3 Kg clover hay. The concentrate mixture composed of 65% undecorticated cotten seed meal, 20% rice bran, 9% wheat bran, 3% molasses, 2% calcium carbonate and 1% common salt. The animals were weighed at 14 day intervals.

After a conditioning period of 60 days, the rams were assigned to two groups of three each having similar body weight and average live weight gain.

The daily diet was then given at the rate of 1 Kg concentrates and ½Kg clover hay per animal. Each of the rams in one group was injected in the tail with stilbestrol at weekly intervals. The dose was given at the rate of 3 mg stilbestrol dipropionate per animal per day. The rams of the other group were used as control.

After 90 days treatment with stilbestrol the rams of the two groups were slaughtered. The carcass and testicular weights were determined. A sample from each testis was fixed in Bouin's solution. Tissue mat sections were stained with hematoxylin and eosin and examined microscopically.

RESULTS AND DISCUSSION

In the stilbestrol treated rams, there was a slight non-significant reduction of the live body weight gain (Table 1). This reduction in weight might be due to the fact that the used ration, with the restricted energy supply, was only adequate for growth but not for fattening, since a high energy ration is needed in order to get the maximum response from stilbestrol supplementation (Cunha, 1971).

The stilbestrol treated rams showed a significant decrease ($P < 0.05$) in the testicular weight (Table 1). The mean testicular weight as percentage of carcass weight decreased by 13.4% to that of the control. Similar results were obtained in rams treated with hexoestrol (Preston *et al.*, 1960).

Histological examination of testes from the stilbestrol treated rams showed atrophied seminiferous tubules. The diameters of the tubules were markedly reduced when compared with those of the control group (Plates 1 & 2) Complete inhibition of the activity of the germinal epithelium was observed. The testes showed predominantly tubules lined principally with spermatogonial cells and highly vacuolated Sertli's cells. The histological picture of the tubules varied in extent of degeneration. Some tubules were more severely degenerated than those shown in Plate 2, while in others, stages up to sper-

Figure 3.

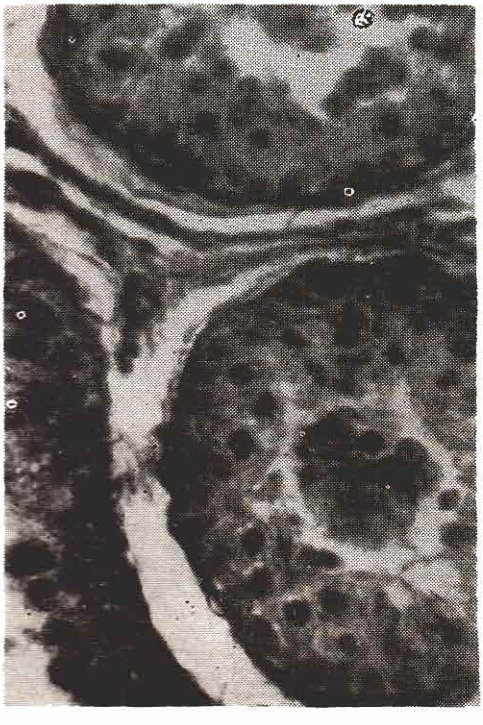

Figure 4.

BLATE 2:

Figure 3. Section in the testis of a stilbestrol treated ram. (X 120).

Figure 4. Same seminiferous tubules shown in figure 3, with higher magnification. (X 300).

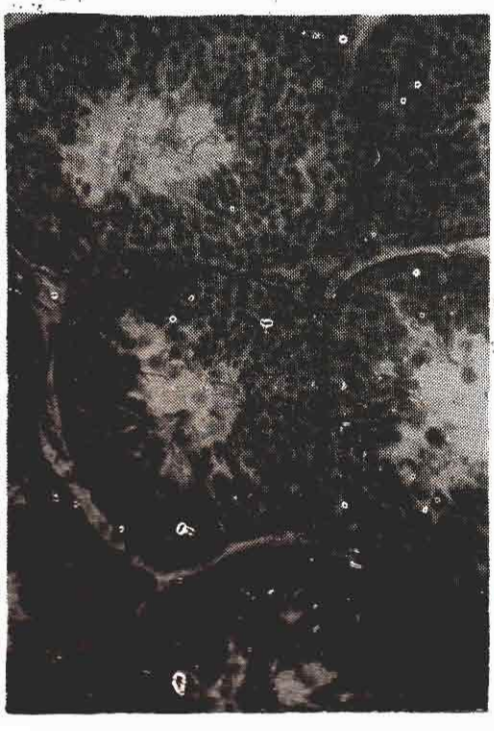

Figure 1.

Figure 2.

PLATE 1:

Figure 1. Section in the testis of a control ram, showing normal development of the seminiferous tubules and highly active spermatogenesis. (X 120)

Figure 2. Same seminiferous tubule shown in figure 1, with higher magnification. (X 300)

TABLE 1. Effect of stilbestrol dipropionate on the average weight of carcass and testicle of yearling Rahmani rams.

	Final live weight (Kg)	Carcass weight (Kg)	Testicular* weight (g)	Testicular weight as % of carcass weight
Control	62.3	30.66	437.3	1.416
C. V.%	5.06	4.30	1.41	11.97
Treated	57.0	26.66	327.6	1.233
C.V.%	5.26	9.26	2.07	11.38

* Including the epididymal weight.

matids could be observed. No spermatozoa were found. Intra-luminal aggregates of exfoliated germ cells up of the stages of spermatocytes were observed in the seminiferous tubules. The spermatogonial cells seemed to be undisturbed in most of the tubules of the treated animals, however, their mitotic activity was inhibited. Normal-shaped Leying cells were absent in the seminiferous tubules of the stilbestrol treated animals. The Leydig cells were found in aggregates of a rather collaginized interstitial tissue. Their nuclei were atrophied, cytoplasm was vacuolated and cell outlines were lost.

Bullough (1955) found that all estrogens, whether they were natural or synthetic, acted in a similar way. They posses a mitogenic activity by stimulating the glucokinase system in the cells in which the glucokinase reaction is not normally maximally active. Natural estrogens as well as stilbestrol may also act as mitotic inhibitors when used in high doses.

Clermont and Morgentaler (1955) reported that the gonadotrophin of the pituitary gland act both on the formation of type A spermatogonia and the Leydig cells of the testicles.

This study suggested that prolonged use of stilbestrol in large doses causes damage to the testicular tissue possibly by inhibiting the mitotic activity of the germ cells either directly or most probably indirectly through the pituitary gland.

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HISTOLOGICAL STUDY OF THE OVARY AND ENDOMETRIUM OF EWES SUPPLEMENTED WITH DIFFERENT LEVELS OF VITAMIN A

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(Revised M S received 6 June 1976)

SUMMARY

Twenty nine ewes were used to study the long term effects (12 months) of different levels of vitamin A on the ovarian and endometrial histology. Vitamin A was supplemented orally at the rate of 0, 50,000 and 100,000 I.U. per ewe per month. Vitamin A deficient group had a high percent of atretic follicles, some degree of endometrial damage and low conception rate. Results suggested that the lowered fertility of ewes deficient in vitamin A was mainly due to ovarian dysfunction and partly to endometrial damage.

الخلاصـــــة

اجريت دراسة على عدد ٢٩ نعجة بغرض دراسة تأثير اعطاء مستويات مختلفة من فيتامين أ لمدة ١٢ شهرا على كل من نشاط المبيض والغشاء الخاطي للرحم وقد قسمت النعاج الى ثلاث مجاميع . اعطيت هذه المجاميع فيتامين أ عن طريق الفم بجرعات :

صفر ، ٥٠٫٠٠٠ ، ١٠٠٫٠٠٠ وحدة دولية في الشهر لكل نعجة في المجاميع سالفة الذكر على التوالي .

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لوحظ في المجموعة التى تتغذى على عليقة خالية من فيتامين أ نقص ملحوظ في معدل الاخصاب · كذلك لوحظ زيادة ملحوظة في نسبة عدد حويصلات جراف التى يصحبها ضمور ، في المبيض · كما وجدت بعض التغيرات الهستولوجية التي تشير الى وجود التهابات في الغشاء المخاطي للرحم · لم يلاحظ فروقات واضحة في كل من المبيض والغشاء المخاطي للرحم في المجموعتين اللذان اعطي فيتامين أ بنسب مختلفة ·

من نتائج هذه الدراسة يعتقد ان انخفاض نسبة الاخصاب في مجموعة النعاج التى لم تعطي فيتامين أ كان ناتجا اساسا من الخلل في الوظائف الفسيولوجية للمبيض وثانويا نتيجة الالتهابات التى حدثت في الغشاء المخاطي للرحم ·

INTRODUCTION

Several researchers demonstrated that lack of dietery vitamin A in sheep with depleted vitamin A stores, resulted in impairment of reproductive function. Byers *et al.* (1956) reported that long-time feeding of suboptimal or deficient carotene ration had detrimental effects on the structures of the pituitary, adrenals and thyroid glands as well as ovarian and testicular tissues.

The present investigation was aimed to study the longterm effects of different levels of vitamin A upon the histology of ovaries and endometrium and rate of conception in ewes.

MATERIALS AND METHODS

Twenty nine mature ewes,* 17 Awassi and 12 Awassi X Barki crossbreds, were used in this study. They were fed a dry balanced ration with no vitamin A or carotene throughout the period of the experiment. The ration was composed of wheat straw and a concentrate mixture. The latter consisted of cotton seed meal 65%, rice polishing 20%, wheat bran 9% malasses 3%, lime stone 2% and common salt 1%. The basal ration was given according to Morrison feeding standards (Morrison, 1955).

* Animals used in this study were obtained from those used in a previous experiment by Sooud *et al.* (1973).

The ewes were assigned to three groups (T_1, T_2 and T_3) which received vitamin A* orally in the rate of 0, 50,000 and 100,000 I.U. per ewe per month respectively for 12 months. Blood plasma vitamin A was assayed at monthly intervals over the experimental period using the Carr-Price reaction with antimony trichloride.

After a period of three months on vitamin A supplementation the ewes were allowed to be mated, using three fertile rams. The rams were allocated at random to the treated groups. Each ram was supplemented with 100,000 I.U. of vitamin A orally every month during the mating period which lasted for 51 days.

At the end of the feeding experiment, just after weaning of the newly born lambs at the age of four months, the ewes were sacrificed. The reproductive organs were dissected out and weighed. Ovarian and uterine tissue samples from each ewe were fixed in Bouin's fluid for histological study. Tissue mat sections were stained with hematoxylin and eosin and examined microscopically. Analysis of variance of data and tests of significant were done according to Steel and Torrie (1960).

RESULTS AND DISCUSSION

The reproductive performance of ewes used in present study were reported by Soond *et al.* (1973). Data observed in this study are summarized in Table 1. There was a significant effect of vitamin A supplementation on the number of ewes conceived ($P < 0.01$). However, conception rate, weight of ovaries and uterus were not different in the two groups which received vitamin A.

Histological examination of the ovaries:

The greatest diameter of the follicles in the sections of the left ovary of each ewe was microscopically measured. The boundary line was between the theca and stroma. Each measured follicle was then classified as either apparently normal or atretic (Table 2). In vitamin A deficient

* A-Viton, Kahera Pharm. & Chim. Ind. Co., Cairo, U.A.R.

group, T_1, follicles greater than 5 mm in diameter were not observed and the number of atretic follicles greatly exceeded that of apparently normal vesicular follicles. The proportion of atretic and apparently normal vesicular follicles as well as the proportion of the different types of atresia in the left ovary of the three groups were presented in Figure 1. Classification of the different types of artresia as, early, definite and late, was done according to Marion *et al.* (1968) and Choudary *et al.* (1968).

One of the first signs of early follicular atresia was the appearance of epithelial irregularities of the granulosa cells. The latter became loose and attained different shapes and sizes (Figure 2). The flattened outermost cell

TABLE 1. Effect of different levels of vitamin A on certain reproductive traits in ewes.

Parameters	Treatment groups* T_1	T_2	T_3
No. of ewes mated	9	10	10
No. of ewes conceived**	1	5	8
No. of lambs born alive	0	5	8
Ave. level of blood plasma vit. A at end of the experiment, ug/100 ml	7.2	49.5	49.3
Range of blood plasma vit. A during the experiment ug/100 ml	7.2 _ 33.7	21.9 _ 84.1	38.9 _ 72.9
Ave. wt. of the genital tract, g***	39.20 ± 4.1	35.08 ± 3.9	34.04 ± 3.9
Ave. wt. of ovaries, g	1.78 ± .07	1.62 ± .067	1.50 ± .067
No. of ewes having follicles greater than 5 mm in diameter	0	2	7
No. of ewes having corpora lutea	1	3	4

* T_1 = received no vitamin, T_2 = received 50,000 I.U. T_3 = received 100,000 I.U.

** Ewe reported as conceived was that which had either a lamb or which aborted.

*** Include, (ovaries, fallopian tubes, uterus, cervix, vagina and vulva).

TABLE 2. Number of atretic follicles observed in the left ovaries of the three groups treated with vitamin A.

Follicular size classes (mm)	T_1 No. of follicles studied	T_1 No. of atretic follicles	T_2 No. of follicles studied	T_2 No. of atretic follicles	T_3 No. of follicles studied	T_3 No. of atretic follicles
1	22	15	6	1	16	2
2	13	12	18	8	15	5
3	6	4	2	2	6	1
4	3	3	2	1	3	1
4.1	1	0	3	0	9	0

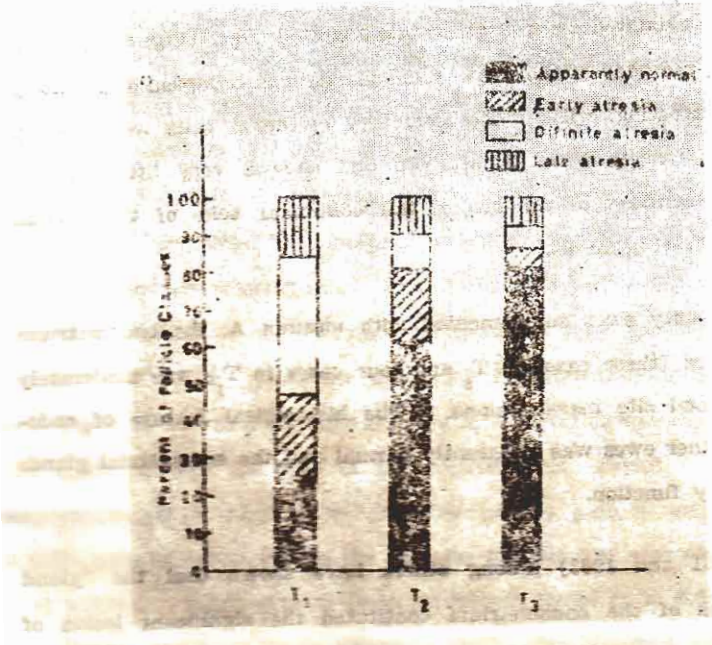

Figure 1. Proportion of normal and atretic vesicular follicles classified as to the stage of atresia. The proportion represent follicles in the left ovaries of the three treated groups. T_1, T_2 and T_3 groups received orally 0, 50,000 and 100,000 I.U. of vitamin A / month respectively.

layer of the granulosa disappeared either partly or completely. Atretic bodies were most frequently observed in the lumen (Figure 3). This finding agrees with that of Marion *et al.* (1968) in that the disappearance of the membrana propria was less commonly observed in early atresia. Detachment of the granulosa cell layers into the antrum as well as thickening of the theca layers were considered as signs of definite atresia (Figure 4). In late atresia (Figure 5), most of the granulosa cells were sloughed out in the antrum. The theca layers were greatly thickened showing various degrees of hyalinization and the follicular lumen was greatly reduced.

Histological study of the endometrium:

Microscopical examination of the endometrium revealed that most of the ewes on vitamin A deficient diet, T_1, had some degree of tissue damage; a case exhibited endometrial fibrosis of the glandular tissue (Figure 6). The other eight cases exhibited severe "gland site mass" lesions (Figure 7). In the latter lesions, the body of the endometrial glands was collapsed and densely packed with infilterating cells. The secretory epithelial cells were closely packed, stained intensely with hematoxylin and showed very little nuclear differentiation in contrast to the larger, tall collumnar cells of the normal endometrial glands (Figure 8).

From the twenty ewes supplemented with vitamin A, the endometrium of only seven cases (three cases in T_2 and four cases in T_3) was moderately affected with 'gland site mass' lesions. The histological feature of endometrium of the other ewes was apparently normal and the endometrial glands exhibited secretory function.

Dawson (1961 and 1963) among others have shown that the "gland site mass" lesions of the endometrium contituted the significant lesion of endometritis. He also added that such lesions do not , in themselves, preclude conception but tend to prejudice the development of the embryo from the time of implantation.

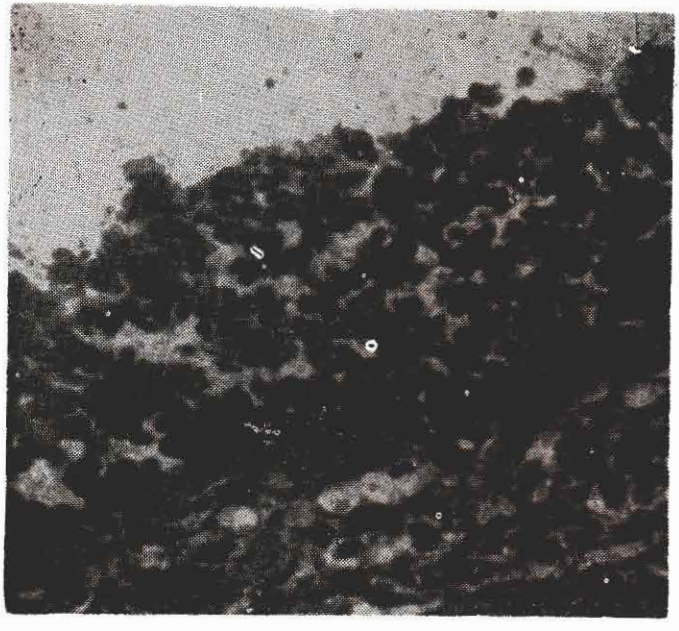

Figure 2. Section in a follicle showing signs of early atresia. The granulosa cells are loose and of different shape and size (650 X).

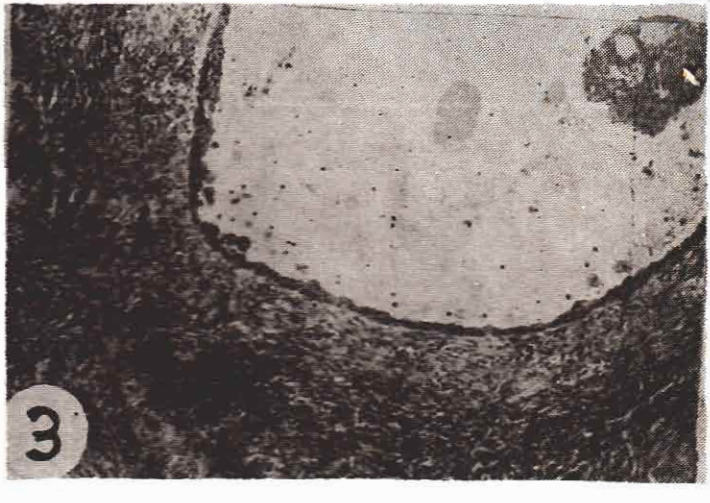

Figure 3. Section in a follicle showing signs of early atresia. Atretic bodies are observed in the antrum (120 X).

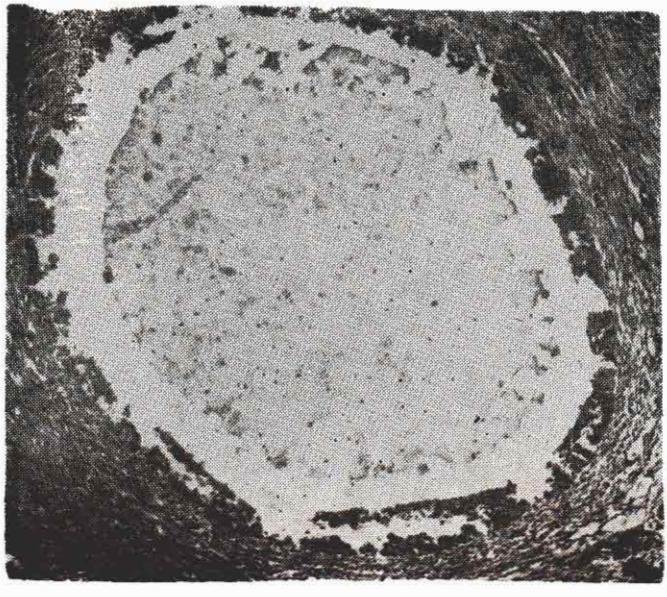

Figure 4. Section in a follicle showing detachment of the granulosa cell layers (160 X).

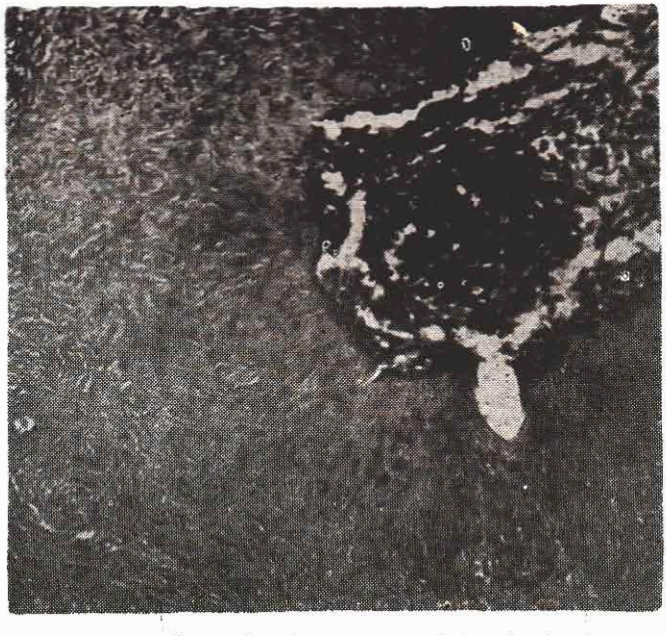

Figure 5. Section in a follicle showing signs of late atresia (320 X).

Figure 6. Section in an endometrium in which most of the glandular tissue is replaced by fibrous tissue (200 X).

Figure 7. Section in an endometrium showing "gland site mass" lesions (200 X).

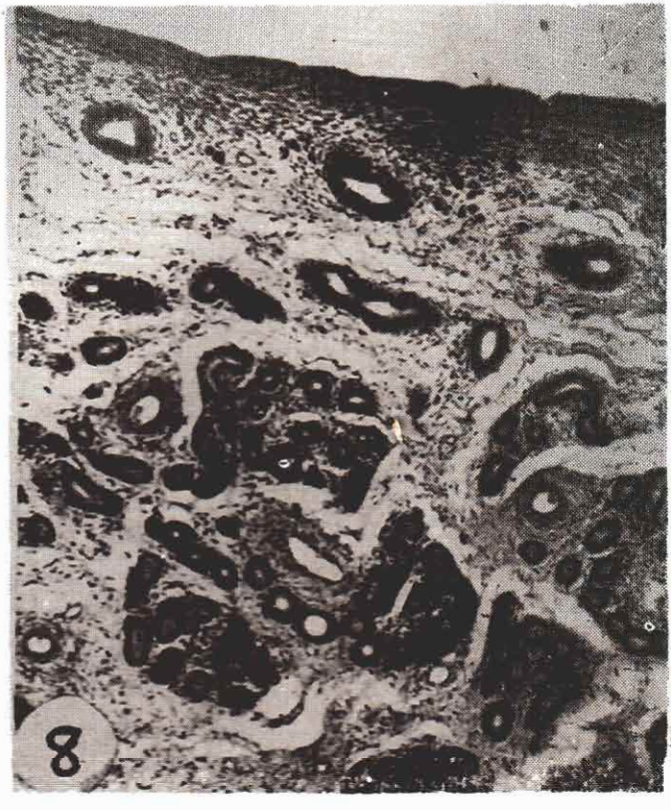

Figure 8. Section of apparently normal endometrium. The endometrial glands are lined with tall columnar secretory cells (200 X).

The present data suggested that the lower fertility of the ewes associated with vitamin A deficiency was mainly due to ovarian dysfunction and partly to endometrial damage.

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EFFECT OF LENGTH OF FATTENING PERIOD ON FEEDLOT PERFORMANCE AND CARCASS TRAITS IN JENOUBI CATTLE IN IRAQ

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SUMMARY

A total of thirty male calves of the native Jenoubi breed, divided into six treatment groups, were used to study the effect of length of fattening period on gain in weight and carcass traits. Work was carried out at the Experimental Farm of the College of Agriculture in Alamria.

Final, slaughter and carcass weights increased and daily gain decreased as the fattening period increased. Dressing percentage, fore quarter and hind quarter weights also increased with the extended fattening period. Significant and possitive regression coefficient was obtained between slaughter weight and hot carcass weight (0.539 Kg). Carcass weight had a positive and significant effect on weight of different cuts. Area of rib-eye muscle was highly correlated with carcass weight ($r = 0.612$).

Fattening native calves up to weights ranging between 250 and 300 Kgs could result in improving their performance, as well as, their carcass traits.

الخلاصـــــــة

استخدمت في هذه التجربة ثلاثون عجلا من الابقار الجنوبية المحليـــة في العراق بغرض دراسة تأثير طول فترة التسمين على بعض صفات الجسم والذبيحة. وقد اجريت هذه التجربة في المزرعة التجريبية لكلية الزراعة ـ جامعة بغـــداد بالعامرية . قسمت العجول عشوائيا الى ٦ مجاميع حسب طول فترة التسمين . وقد ذبحت المجموعة الاولى بعد فترة ١٤ يوما من بدأ التجربة ثم ذبحت بقيـــة المجاميع على فترات متساوية طول كل منها ٤ أسابيع .

اثرت طول فترة التسمين بالزيادة على وزن العجول عند الذبح والزيادة الكلية ووزن اللشة علما بانه لم تلاحظ فروق معنوية في الوزن المبدئي في حين نقص الزيادة اليومي بزيادة طول فترة التسمين . كما ان نسبة التصافي محسوبة على اساس وزن الحيوان الفارغ ووزن الارباع الامامية والخلفية ونسبة اللحم في قطيعة الضلع ٩ ـ ١٢ قد ازدادت بزيادة طول فترة التسمين .

وجد ان معامل اعتماد وزن اللشة على الوزن عند الذبح معنويا ومقداره ٠ر٥٣٩ ، كما وان العلاقة بين وزن اللشة ووزن القطيعات المدروسة كانت موجبة ومعنوية . ومعامل الارتباط بين مساحة العضلة العينية ووزن اللشة معنويا وقيمته ٠ر٦١٢ وعليه فيكون من الافضل اجراء التسمين للعجول العراقية الى اوزان تتراوح ٢٥٠ ـ ٣٠٠ أو اكثر حتى تتحسن صفات اللشة لهذه الحيوانات .

INTRODUCTION

In the last decade the quantity of meat imported for consumption has been progressively increasing, as the local production falls short of meeting the demand (Ahmed and Al-Roumi, 1967). This is partly due to the relatively light slaughter weights (150—180 Kg), and possibly due to short fattening periods. Kharoofa (1975) obtained final weights of Jenoubi calves fattened for a period of 86 days of 177 Kgs.

The aim of the present study is to investigate the effect of the duration of the fattening period on the feedlot performance and carcass traits of native Jenoubi calves.

MATERIALS AND METHODS

Thirty male calves of the Jenoubi breed of cattle, 1.5-2.0 years of age, purchased from the Soueira Farm belonging to the General Company of Animal Production, Ministry of Agriculture and Agrarian Reform, were used in this experiment. Animals were trasfered to the Experimental Farm of the College of Agriculture at Al-Ameria, weighed individually upon their arrival and randomly assigned to six treatment groups of five animals each. A preparatory period of 10 days, during which normal procedures of vaccination and spraying of animals took place, preceeded the experimental period. The six treatments differed in the length of the fattening period, starting on 12 February 1975. Calves of all treatments received a concentrate diet at a rate of 2% of average live-body weight. The diet consisted of 60% ground barley, 22% wheat bran, 15% sunflower meal, 2% limestone and 1% common salt. Green Alfalfa or green barley was offered *ad libitum* according to its availability.

Animals of the first group were slaughtered after staying 14 days in the feedlot, while those of the other treatments were sacrificed at 28-day intervals. Animals were weighed fortnightly after a 12-hour fasting period.

Hot carcass weight and weight of different cuts and organs were recorded for each animal. Empty body weight was obtained for each animal by subtracting the weight of the digestive tract content from its slaughter weight. The left half of each carcass was then chilled at approximately 4°C for 48 hours. Hedrick *et al.* (1965) reported that the left side of carcass had higher correlation with total and retail yield of carcasses than the right one. The cuts studied included fore and hind quarters and the 9—12th rib cut. A physical separation for each rib cut into bone and edible portions was made. The area of the rib-eye muscle between the 12th and 13th rib was obtained, using tracing paper and a polar compensating planimeter and as described by Henderson *et al.* (1966).

Statistical handling of the data was carried out according to Steel and

Torrie (1960), and tests of significance were done according to Duncan's Mutiple Range Test (1955).

RESULTS AND DISCUSSION

Means of traits studied in the six treatment groups together with tests of significance for traits tested are given in Table 1. Whereas, the pertaining analyses of varance are given in Table 2. Differences between the 6 groups in initial weight were not significant, showing that the differences observed in each of final, slaughter, hot carcass, fore and hind quarters weights, as well as, dressing percentage based on empty body weight were a direct result of the effect of treatments. In the majority of the traits studied there was no apperciable difference between groups V and VI, namely those fattened for 18 and 22 weeks, respectively.

A relatively high daily gain of 0.972 and 0.884 Kg was attained in groups I and II, which decreased sharply in groups III to VI varying between 0.566 and 0.437 Kg (Table 1). The difference between both sets in daily gain was significant ($P < 0.05$). Animals used in this experiment were purchased by the Soueira Farm from local markets where the quality and quantity of feeds given are poor and inadequate. They were then put on the fattening ration, consisting mainly of concentrates, accordingly they gained rapidly during the first few weeks. Another possibility for the observed decrease in daily gain might be due to a gradual increase in ambient temperature starting from late April through the rest of the experimental period. Such rise in temperature affects food intake, and consequently, gain in weight. A decline in daily gain of calves during the summer months was also observed by Galal *et al.* (1973). Daily gain in Iraqi calves was found to be 0.544 Kg by Juma *et al.* (1972), and 0.433 Kg by Kharoofa (1975) corresponding with that obtained here for animals that were fattened for extended periods. However, higher values for daily gain in Iraqi calves were reported by Kassir *et al.* (1969) and Juma *et al.* (1971), being 0.889 and 0.718 Kg, respectively. Ragab and Abd

TABLE 1. Means of performance and carcass traits of groups of Jenoubi bull calves fattened for different periods.

Traits	Groups I	II	III	IV	V	VI
Fattening period (days)	14	42	70	98	126	154
Final weight (Kg)	180	178.6	173.2	189.2	178.4	192.8
Initial weight (Kg)	193.6b	215.7b	213.2b	245.2a	246.6a	260.1a
Slaughter weight (Kg)	190.2b	206.4b	211.3b	238.8a	246.6a	260.1a
Hot carcass weight (Kg)	103.6c	113.2c	113.6c	126.5b	135.1ab	141.8a
Daily gain (Kg)	0.972a	0.884a	0.520b	0.566b	0.541b	0.437b
Dressing % (live wt.)	54.47	54.84	53.76	52.97	54.79	54.52
Dressing % (empty wt.)	58.89c	61.04b	63.06a	62.65a	63.46a	63.35a
Fore quarter wt. (Kg)	28.5d	30.5c	28.3d	33.9bc	36.2ab	39.5a
Hind quarter wt. (Kg)	22.8d	24.3c	23.6d	27.1b	26.9b	30.1a
9—12 rib cut wt. (Kg)	3.68	4.81	3.38	4.98	4.58	5.50
% edible 9—12 rib cut	75.72	78.05	77.41	75.26	78.40	81.03
% bone 9—12 rib cut	24.28	21.95	22.59	24.74	21.60	18.97
Area of eye muscle $(cm)^2$	59.2	72.8	64.8	67.2	72.8	67.8
Liver weight (Kg)	2.61	2.48	2.84	3.26	3.44	3.0
Heart weight (Kg)	0.86	0.58	0.96	0.86	1.0	0.92
Kidney weight (Kg)	0.43	0.55	0.54	0.51	0.85	0.72
Kidney fat weight (Kg)	0.39	—	0.62	1.02	1.14	—
Visceral fat wt. (Kg)	0.86	1.06	1.48	1.84	2.12	2.54
Head weight (Kg)	13.2	12.8	13.5	14.0	14.9	15.6
Lung weight (Kg)	2.90	2.05	2.68	3.14	3.16	2.90
Feet weight (Kg)	4.6	4.4	5.0	4.8	5.8	5.3
Pelt weight (Kg)	17.1	17.7	17.7	17.5	18.2	19.9
Digestive tract wt. (Kg)						
a. Full	22.4	31.6	40.7	53.3	42.0	46.9
b. Empty	8.1	10.8	9.2	8.8	8.6	10.7
Spleen weight (Kg)	0.68	0.50	0.76	0.86	0.97	0.98
Reproductive tract weight (Kg)	2.00	1.10	1.52	2.12	1.84	1.86

TABLE 2. Analysis of variance of some of the traits studied in Jenoubi bull calves fattened for different periods.

Traits studied	Mean squares	
	Between groups (i)	Within groups (ii)
Initial weight	274.4	340.8
Slaughter weight	3630.2**	383.8
Carcass weight	1073.3**	139.7
Daily gain	0.239**	0.025
Dressing % (Empty weight)	16.09**	1.11
Area of rib-eye muscle	29.47	61.63
Hind quarters weight	37.24**	6.63
Fore quarters weight	101.5**	13.7
Edible % 9—12 *th* rib cut	31.13	21.0

(**) $P \leq 0.01$.

(i) Based on 5 degrees of freedom.

(ii) Based on 24 degrees of freedom.

TABLE 3. Analysis of covariance for some of the traits studied in Jenoubi bull calves fattened for different periods.

Traits Studied	Reduced mean squares		
	Between groups (i)	Within groups (ii)	$b_{X/Y}$
Slaughter wt. / Initial wt.	2532.0**	56.12	0.584**
Carcass wt. / Slaughter wt.	14.20	29.37	0.539**
Area of rib-eye / carcass wt.	9.42	39.94	0.405**
Hind quarter wt. / Carcass wt.	4.03**	1.08	0.20**
Fore quarter wt. / Carcass wt.	6.80	4.34	0.261**
Edible % 9—12 rib cut/Carcass wt.	10.92	19.47	0.13**

(**) $P < 0.01$.

(i) Based on 5 degrees of freedom.

(ii) Based on 23 degrees of freedom.

El-Salam (1962) found an average daily gain in Egyptian calves, 12 and 18 months of age, to be 0.439 Kg, which is similar to the daily gain attained by calves in group VI of the current work.

There was an appreciable and significant increase of almost 2% in dressing percentage, based on emphy body weight, of group II over group I. The trend of increase in dressing percentage continued for those animals fattened for 10 weeks leveling, somewhat, thereafter. Juma *et al.* (1972) found that the dressing percentages, based on livebody weight, in Iraqi calves was 50.45% being lower than the figures obtained in this study. Kassir *et al.* (1969) and Juma *et al.* (1971) reported dressing percentages for Iraqi bull calves of 50.0 and 51.2%, respectively.

An increase in the weight of hind quarters was associated with the increase in the length of the fattening period from 18 to 22 weeks. The same was true in the weight of the 9—12*th* rib cut and its percent edible portion increasing by 2.6% over the same period. Percent bone of this cut was accordingly reduced in group VI to 18.97%, being the lowest in the six treatments.

The relationship existing between initial weight and slaughter weight is known to be important and could mask real group differences. Accordingly, an analysis of covariance was performed between these two traits, together with other important relationships, and presented in Table 3. A considerable reduction in within group varibility resulted because of the almost unity correlation coefficient between both traits, being 0.93. An increase of 0.98 Kg in slaughter weight was estimated for each Kg increase in initial weight.

High and significant regression coefficients were observed between hot carcass weight and some carcass traits and are presented in Table 3. The regression of carcass weight on slaughter weight of 0.54 Kg might be looked at as the intra-group dressing percentage based on live-body-weight basis. It is a weighed average of the dressing percentage of the different groups.

Highly significant regression coefficients of area of rib-eye muscle, fore and hind quarters weights on carcass weight, of 0.405 cm^2, 0.261 and 0.20 Kg, were found respectively feans that there is an increase in the weight of the most prefered cuts in the animals fattened for longer periods. This will result in an increase in the edible portion of carcasses as observed in the 9—12th rib cut. The significant correlation coefficient between area of rib-eye muscle and hot carcass weight of 0.612, obtained in this study, was lower than the estimate of 0.773 obtained by Juma *et al.* (1972). A steady and near linear increase in stored fat; i.e. visceral and kidney fats; was associated with increasing the length of the fattening period.

Better carcass finish is expected to be attained when animals are fattened for longer periods. Accordingly, it might be adisable to keep Jenoubi bull calves of 18 months in age on the feedlot to reach slaughter weights ranging between 250 and 300 Kgs. This will result in better performance and improved carcass traits.

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VARIATION OF SOIL pH READINGS WITH TIME ELAPSED AFTER PREPARING SOIL SUSPENSION

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SUMMARY

An experiment was conducted to determine the influence of time after preparing soil suspension on soil pH as affected by salinity level, water: soil ratio, and microbiological activities.

Samples of soil having an ECe of 1.6 mmhos/cm were salinized to ECe values of 4, 8, 16, and 32 mmhos/cm. Suspensions with water: soil ratios of 0.5 : 1, 1 : 1, 2.5 : 1, 5 : 1, and 10 : 1 were prepared and the pH was measured at 1, 5, 10, 20, 40, 80, and 160 h after preparation.

The pH varied over 1 pH unit with increasing water : soil ratio from 0.5 : 1 to 10 : 1. The variation in time caused a change in the order of 0.5 pH unit. There was statistically significant difference in pH values for the water system as compared to the $HgCl_2$ treated system.

It was shown that the pH of soil varies widely with the variation in water : soil ratio, salinity level, the activity of micro-organisms, and the time of measurement after preparing the suspension. All these factors must be taken into consideration when pH is measured.

الخلاصـــة

التغيرات في درجة الاسس الهيدروجين للتربة (pH) المسببة عن اجراء القياس في فترات مختلفة من تحضير معلق التربة في الماء

اجريت هذه التجربة لتقدير تأثير الزمن المار على تحضير معلق التربة في الماء على قياس درجة الاس الهيدروجيني للتربة ، اضـــافة الى تأثير مســتوى الملوحة ، نسبة الماء الى التربة ، وفعاليات الاحياء المجهرية على هذه الدرجة ٠

نماذج مــن تربة التوصيل الكهــربائي لمســتخلص مشـــبعها (ECe) مساوى لـ ١ر٦ ملموز/سم تم تمليحها الى عدة مستويات هي ٤ ، ٨ ، ١٦ ، و٣٢ ملموز/سم ٠ تم استعمال نماذج من التربة الاصلية والترب المملحة لتحضير معلقات بنسبة ماء الى تربة مساوية لـ ٥ر٠ : ١ ، ١ : ١ ، ٥ر٢ : ١ ، ٥ : ١ ، و ١٠ : ١ ٠ وتم قياس درجة الاسس الهيدروجيني للتربة بعد مرور ١ ، ٥ ، ١٠ ، ٢٠ ، ٤٠ ، ٨٠ ، و ١٦٠ ساعة على تحضير هذه المعلقات ٠

بينت النتائج ان زيادة نسبة الماء الى التربة من ٥ر٠ : ١ الى ١٠ : ١ سببت زيادة في درجة الاس الهيدروجيني للتربة لاكثر من درجة واحدة ٠ اما التغير في زمن القياس فقد سبب تغيرا في درجة الاس الهيدروجيني مقداره نصف درجة ٠ وكانت هنالك فروقات معنوية احصائيا في هذه الدرجة بين معلقات التربة والماء ومعلقات التربة ومحلول كلوريد الزئبق ٠

بينت النتائج ان قيمة درجة الاس الهيدروجيني للتربة تتغير بشدة مع تغير نسبة الماء الى التربة ، مستوى الملوحة ، فعاليات الاحياء المجهرية ، والزمن المار على تحضير المعلقات ٠ كل هذه العوامل يجب ان تؤخذ بنظر الاعتبار عند قياس درجة الاس الهيدروجيني للتربة ٠

INTRODUCTION

Soil pH is an important property that is measured more often than any physico-chemical property of the soil. Normally, the pH of soil suspension (soil suspension is used throughout this article to mean both soil suspension and/or soil paste) is measured one hour after preparation (Richards, 1954). In many soil laboratories, the pH usually measured from one to many hours or even days after preparing the suspension. Different water : soil ratios have been used by different investigators in the preparation of soil suspension for pH measurement. Peech (1965) stated that the pH of soil increases as the water content increases from the moisture equivalent to a water : soil ratio of 5 : 1.

This is true regardles of the initial pH of the soil and the distilled water used. Several other workers (Chapman, *et al.*, 1941; Huberty and Haas, 1940; McGeorge, 1944; Bear, 1955) have shown that upon dilution from the sticky point to a water : soil ratio of 5 : 1 or 10 : 1, the pH value increased over 1 pH unit. This increase in pH is brought about by the decrease in the concentration of neutral salts with dilution (peech, 1965). During 28 years irrigation of citrus-planted arid lands in California, the pH of the top 15 cm of soil increased from 6.8 to 8.0 (Kovda, *et al.*, 1973). The association of the increase in pH with leaching of soluble salts illustrated clearly when a bare mallee soil was leached for three months with a total application of 10 m of water at Merbein, Victoria (Kovda *et al.*, 1973).

Hardan and Abbas (1973) indicated that other natural processes in soil such as oxidation of sulphides and the formation of CO_2 from biological activities and from organic matter decomposition can markedly decrease the pH of soil. The effect of CO_2 at the partial pressure prevailing in the atmosphere is very small in soil when the pH is below 7 (Peech, 1965). Whitney and Gardner (1943) found a straight line relationship between pH of calcareous soil and CO_2 pressure. They concluded that the pH of such soil should be measured after equilibrium with known partial pressure of CO_2 in order to be closely related to the pH of soil in the field. In the U.S. Salinity Laboratory, the pH is measured after equilibrium of the soil with CO_2 pressure of the atmosphere (Richards, 1954).

This work was conducted to determine the influence of time (time between the preparation of soil suspension and the pH measurement) on the pH of soil at different salinity levels as affected by the activity of soil microorganisms and by water : soil ratio.

MATERIALS AND METHODS

A non-saline (ECe = 1.6 mmhos/cm), low in organic matter (1.2%), free of gypsum, silty clay loam soil (28% clay; 64% silt; and 8.0% sand),

with a lime content of 26.6% was collected from the surface layer (0—30 cm) of the agricultural college farm at Aameriah, several km west of Baghdad.

The soil was air-dried and sieved through a 2—mm opening sieve. Samples of this soil was salinized to different levels with solutions of $CaCl_2$, $MgCl_2$, Na_2SO_4, and NaCl at an equivalent ratio of 2:2:1:1, respectively. The proper amounts of single salt solutions were added to portions of the soil and the ECe was measured and adjusted with the same solutions to obtain the desired ECe of 4, 8, 16, and 32 mmhos/cm.

The treated soil portions were air dried and sieved again through a 2—mm opening sieve in order to be used in the investigation. Fifty g samples of the normal or the salinized soil were used to prepare suspensions with water : soil ratios of 0.5 : 1, 1 : 1, 2.5 : 1, 5 : 1, and 10 : 1 using either distilled water or a 40 ppm solution of $HgCl_2$. The $HgCl_2$ was used to reduce the microbiological activities.

Soil pH readings were taken 1, 5, 10, 20, 40, 80, and 160 h after preparing the suspension using a Backman pH meter in a constant temperature room at 18 $\pm$ 1 °C.

RESULTS AND DISCUSSION

Relationship between pH and water : soil ratio is shown in Fig. 1 for the water and the $HgCl_2$ systems. The pH of soil suspension increased significantly (Table 1) with increasing dilution. The slope of the curves in Fig. 1 was greater at lower water : soil ratios than at higher ratios. This was true for all treatments and at all times. The increase in pH with dilution is caused by the decrease in the concentration of neutral salts which caused the detachment of some hydrogen ions from the double layer (Bear, 1955; and Peech, 1965). This is in agreement with the results of many other investigators (Chapman *et al.*, 1941; Huberty and Haas, 1940; McGeorge, 1944). The decrease in the slope of the curves at higher water : soil ratio is caused by the reduction in salt concentration and by the change in the rate of solubility of natural salts. At low water : soil ratio, the total concentration of salts in

solution is much higher than that of the diluted suspension. A small change in water : soil ratio when the salt concentration is high would cause a relatively greater change in the electrolyte concentration of the solution. Therefore, a greater change in pH was observed as compared with the pH changes at higher dilution. This was true for both the water and the $HgCl_2$ systems and at all times.

Fig. 2 shows the influence of EC on the pH of soil suspension at different times. The pH decreased significantly (Table 1) and continuously (Fig. 2) with the increase in salinity. This is in agreement with the findings of other investigators (Kovda, *et al.*, 1973; McGeorge, 1944; and Peech, 1965).

TABLE 1. Analysis a variance for soil pH at different salinity levels, different water : soil ratios, and different times in water and $HgCl_2$ systems.

Source of variation	df	ss	ms	F
Total	699	106.9476	0.1530	
Reps	1	0.0020	0.0020	
$HgCl_2$ (M)	1	7.6359	7.6359	83.5438*
ECe (EC)	4	16.9218	4.2305	46.2856***
Time (T)	6	3.6224	0.6037	6.6050**
Water : soil (W)	4	41.3065	10.3266	112.9825***
M x EC	4	0.2170	0.0543	0.5941
M x T	6	0.8553	0.1426	1.5602
M x W	4	0.0550	0.0138	0.1510
EC x T	24	0.6508	0.0271	0.2965
EC x W	16	0.2540	0.0159	0.1740
T x W	24	1.2696	0.0529	0.5788
M x EC x T	24	1.0065	0.0419	0.4584
M x T x W	24	0.3094	0.0129	0.1411
M x EC x W	16	0.0843	0.0053	0.0580
EC x T x W	96	0.4759	0.0050	0.0547
M x EC x T x W	96	0.3852	0.0040	0.0438
Error	349	31.8960	0.0914	

Coefficient of variation = 3.95%

*** Exceeds 0.5% level of significance.

** Exceeds 2.5% level of significance.

* Exceeds 10% level of significance.

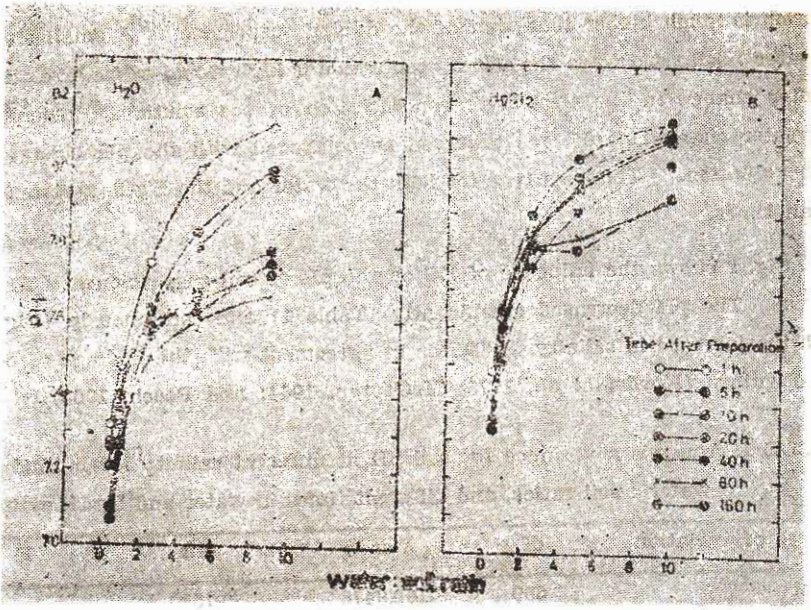

Fig. 1 Relationship between water : soil ratio and average soil pH values for all salinity levels at different times in water and in $HgCl_2$ systems.

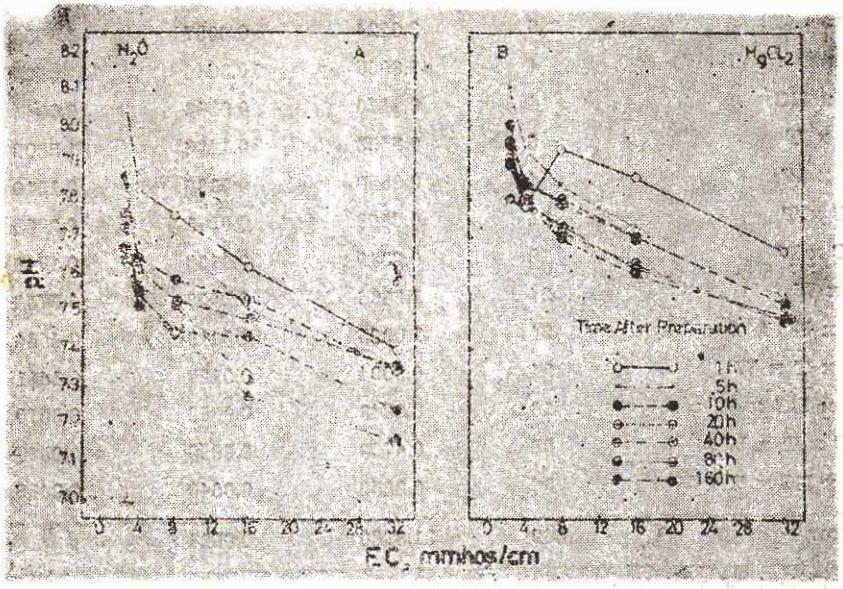

Fig. 2 Relationship between EC and average soil pH values for all water : soil ratios at different times in water and in $HgCl_2$ systems.

The relationship between pH and time is shown in Fig. 3. There is a highly significant relation between pH and time (Table 1). The pH of soil suspension decreased as the time increased from 1 to 80 h then it started to level-up after that. Whether the change in slope of the curves took place at 80 h or after is not known since no readings were taken in between 80 and 160 h. For the $HgCl_2$ system, the variation of pH with time was not as that for the water system and the trend was not similar for all water : soil ratios (Fig. 3B). Reducing the micro-biological activities with $HgCl_2$ gave significantly higher pH values than those of the water system (Table 1). For the water system, the greater reduction in pH was caused by the production of CO_2 from micro-biological activities (Hardan and Abbas, 1973) which was partially inhibited when $HgCl_2$ was used.

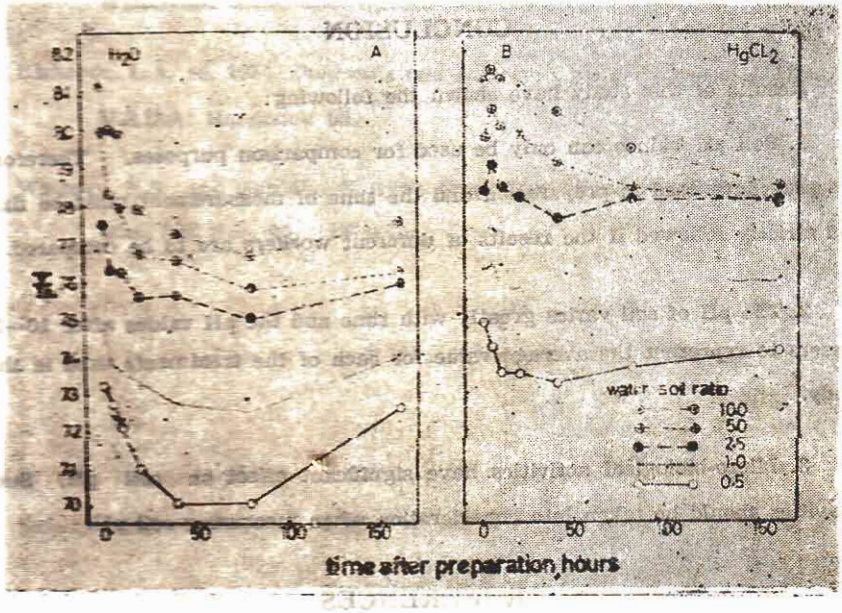

Fig. 3. Dependence of average soil pH values for all salinity levels on time after preparing soil suspension for different water : soil ratios in water and in $HgCl_2$ systems.

Results of this study show that at least two factors contribute to the changes in soil pH time when the salinity level and the water : soil ratio are fixed. These are, chemical factor and micro-biological factor. The increase in pH for the water system after 80 h is probably braught about by the extinction and decomposition of certain types of micro-organisms and the growth of new types. After 160 h, green algae started to grow in the water system.

If the average value of pH is taken for each ratio of water: soil, it comes close to the pH value of the same treatment after 10—20 h.

Statistical analysis (Table 1) indicates that there is no significant interaction of the first, second, or third order between time, EC, $HgCl_2$ treatment, and water : soil ratio in their influence on soil pH.

CONCLUSION

Results of this study have shown the following:

1. Soil pH values can only be used for comparison purposes. Therefore, the procedure used in preparation and the time of measurement must be fixed and strictly followed if the results of different workers are to be compared.

2. The pH of soil varies greatly with time and the pH values after 10—20 h seem to represent the average value for each of the treatments used in this study.

3. Micro-biological activities have significant effect on soil pH. Such activities should be taken into consideration when measuring soil pH.

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CLAY MINERAL CONTENT, CHEMICAL COMPOSITION, GENESIS AND ORIGIN OF AL-GA'ARA CLAY DEPOSITS (Western Desert, IRAQ)

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SUMMARY

The clay minerals content, chemical composition, genesis and provenance of the clays from Al-Ga'ara depression (locality Chabd el Mlusi) Western Desert, Iraq, were investigated. These clay deposits are of Triassic age and related to the Ga'ara Sandstone Formation.

From the X-ray diffraction, the differential thermal analyses and the electron microscope study it has been found that kaolinite is the predominant clay mineral in the clay deposits, and the content of kaolinitc could be evaluated approximately.

The Triassic clays of Al-Ga'ara depression were deposited under fresh water conditions and their source were the deeply weathered acidic igneous rocks of the Arabian Shield.

الخلاصـــــة

تمت دراسة محتوى المعادن الطينية والتركيب الكيميائي والمصدر وكيفية نشوء الترسبات الطينية في جبد الملوصي ضمن منخفض الكعارة ، في الصحراء

الغربية من العراق • ان هذه الترسبات كانت قد تكونت في العصر الثلاثي وتعود الى تكوين الكعارة •

نتيجة للدراسة بواسطة الاشعة السينية والتحليل الحرارى التفـــاضلى والمجهر الالكتروني وجد ان هذه الترسبات الطينية تحوى على نسب عالية مـــن الكاولينايت •

ومن المقترح ان نشوء الترسبات الطينية لمنخفض الكعارة قد تم تحت ظروف المياه العذبة • كما ويعتقد بأن مصدر هذه الترسبات هو من تآكل الصخور النارية الحامضية للدرع العربى (Arabian Shield) .

INTRODUCTION

The clay deposits were discovered within the Ga'ara Sandstone Formation by a group of Iraqi and Russian geologists in 1963 while they were exploring for iron ores. Drilling of the first boreholes started by an Iraqi group (Al-Rawi, I. and Dhiya'a Y.) in 1965, at the locality Chabd el Mlusi in South Western part of Ga'ara depression. In 1971 a further investigation took place in an area located on the eastern part of Chabd el Mlusi. The clay deposits of Al-Ga'ara Formation could be exploited for the industry of various ceramic products, and for that reason the clay minerals content, chemical composition, genesis and origin of these clays were studied.

LOCATION AND GEOLOGY

The clay deposits belong to the Ga'ara Sandstone Formation, which is of Middle Triassic age. They are situated on the stable shelf of the alpino-himalayic geosyncline, and the basement of these Triassic sediments up to the Miocene sediments builds the Arabo-Nubic shield.

The oldest rocks of the stable shelf in the western part of the Western Desert are the coloured Triassic clays and sandstones with kaolinitic and ferriferous matrix (Kuzvart and Urban 1970). They belong to the Ga'ara Formation. These rocks crop out on the bottom of the 100—170 m high down-sloping cliffs,

which border the Ga'ara depression (area of 65 x 25 Km). Further on, the Triassic rocks appear as hills in the Ga'ara depression. The cliffs, formed at the base by Triassic rocks consist further on of Jurassic limestone and dolomitic limestone of the Ubaid and Muhaiwir Formation and in the upper parts of Cretaceous sandstones of the Rutba Formation. In the site of the sampled areas the Triassic sediments are overlaid unconformably by the transgressive Tayarat Formation (Upper Cretaceous). The unconformity is due to erosional and/or non depositional break.

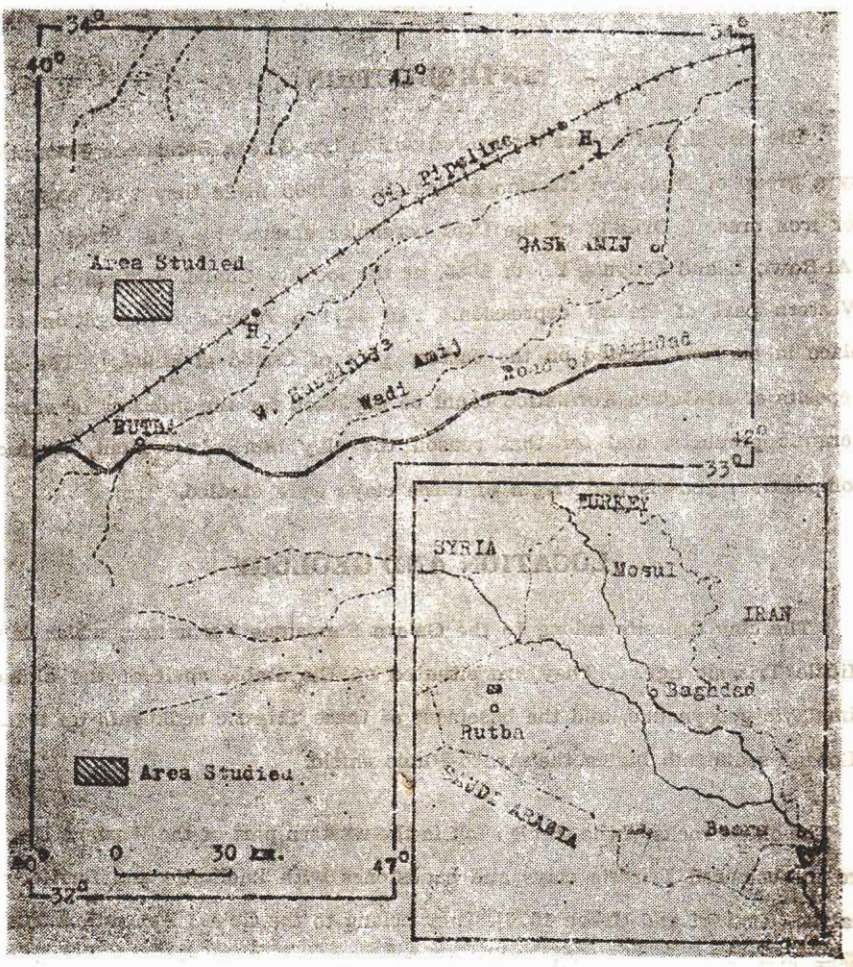

Fig. 1. Location of the study area.

The clays analysed have been sampled from chabd el Miusi at latitude 33° 32' 10" N, longitude 40° 11' 50" E. This area is located in the south western part of Ga'ara depression about 100 Km north of Rutba Town as shown in the location map (Fig. 1).

The clay deposits which are generaly unfossiliferous, but sometimes bearing plant remains, are within the Middle Triassic Ga'ara sandstone. In general they alternate rhythmically with multicoloured sand and sandstone; very minor lenses of iron ores are encountered within the clays and sometimes within the sandstone. This is shown in the correlative geological section through the boreholes Nos. 12 & 20 (Fig. 2). The depths at which samples were collected are given in Table 1.

TABLE 1. Samples of Al-Ga'ara ceramic clay (Fig. 2).

Sample	Borehole No. 20 Interval in meters	Sample	Borehole No. 12 Interval in meters
1	11.80—13.00	5	5.45— 6.20
2	13.00—14.10	6	18.85—19.70
3	21.95—22.65	7	27.50—27.90
4	24.30—24.90	8	27.90—28.50

ANALYTICAL TECHNIQUES

Clay mineral analyses: The clays were analysed by the X—ray diffraction and the differential thermal analyses. The clay samples were treated to remove the calcareous and organic matter and iron compounds (Jackson, 1956). The treated clay samples were fractionated to obtain the clay of 2—0.2 u particle size. These fractions were divided into 2 parts, one saturated with Mg, and the other wth K. The saturated clay samples were oriented on glass slides and each sample was X-rayed in the dry state (K and Mg

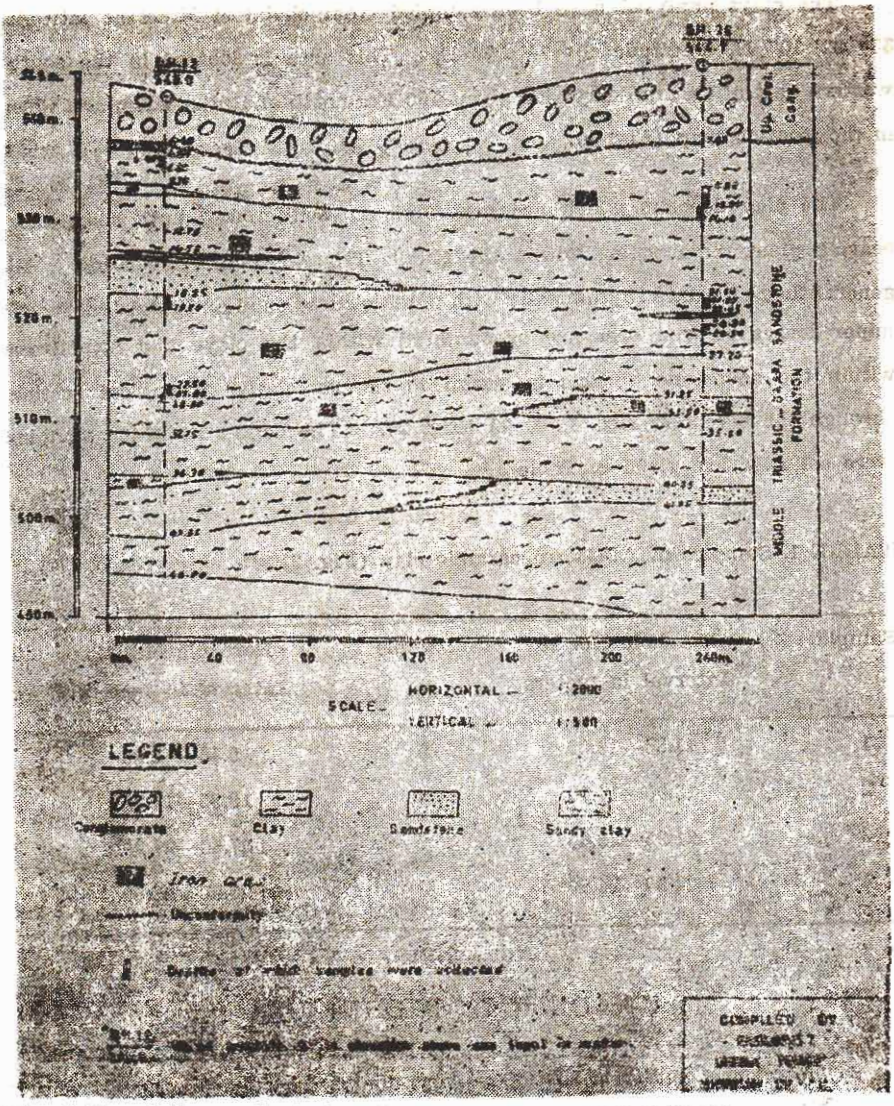

Fig. 2. Correlative geological section through B.H. 12 & B.H. 20.

saturated), after being glycerated, treated with ethylene glycol after being heated to 550°C for 2 hours. X-ray diffraction diagrams were obtained with the use of Phillips X-ray diffractometer with a proportional counter, copper radiation and nickel-filter (Figs. 3,4 & 5).

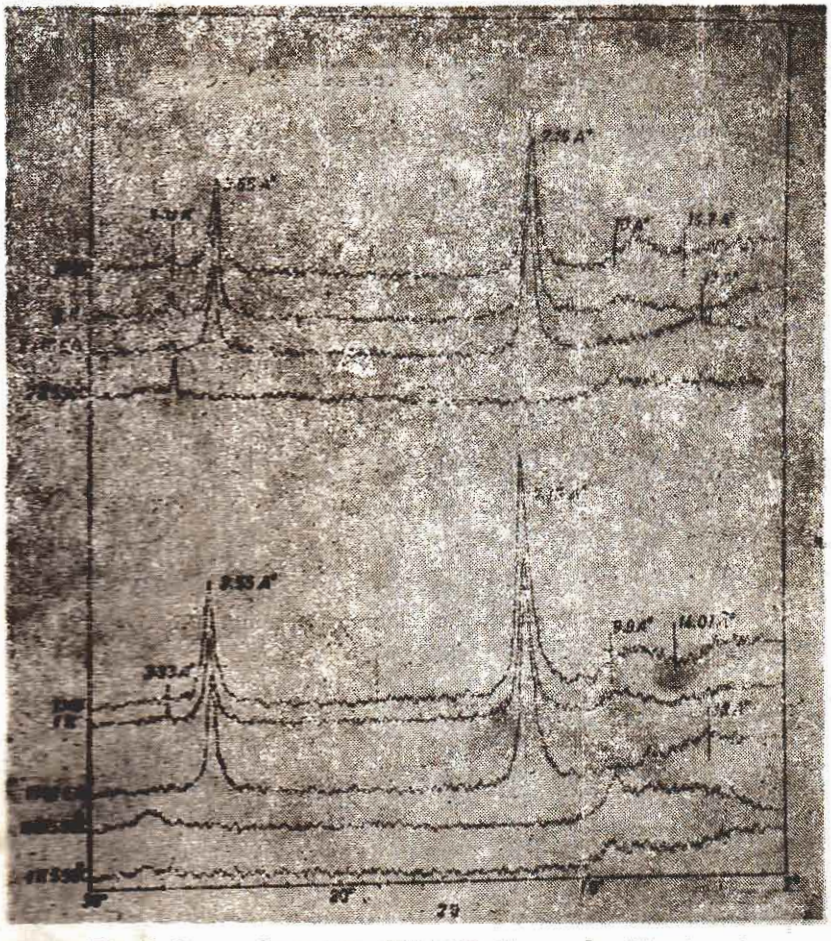

Fig. 3. X-ray diffraction diagrams of samples No. 1 & 2.

The differential thermal curves (Fig. 6) were obtained with the use of "Linsess Prufgeratebau" differential thermal analyser. The rate of heating was 5°C/1 min. The analyses were carried with the clay fractions of about 2 u particle size, and equal amounts of each sample were used to fill the platinum tube in the D.T.A. machine (about 0.6 g). Kaolinite from Drybranch, Georgia, U.S.A. was used as a standard.

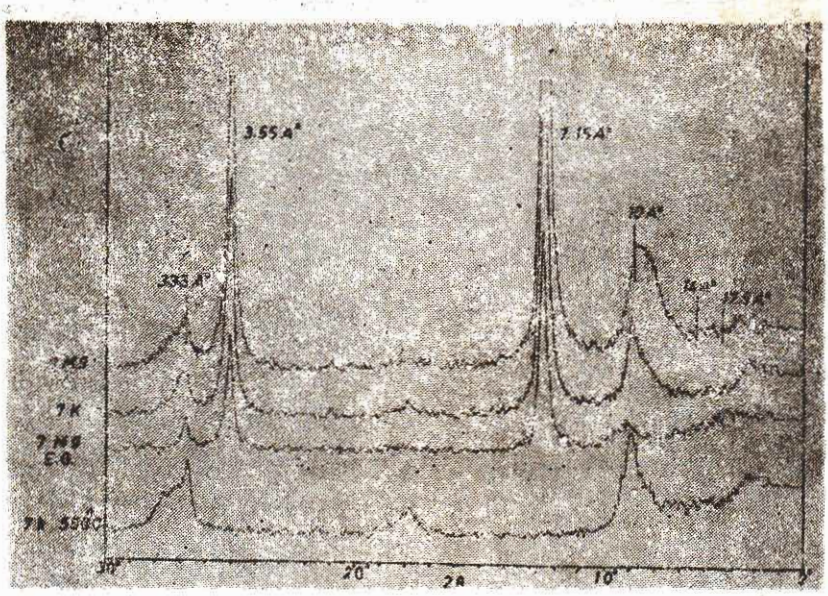

Fig. 4. X-ray diffraction diagram of sample No. 5.

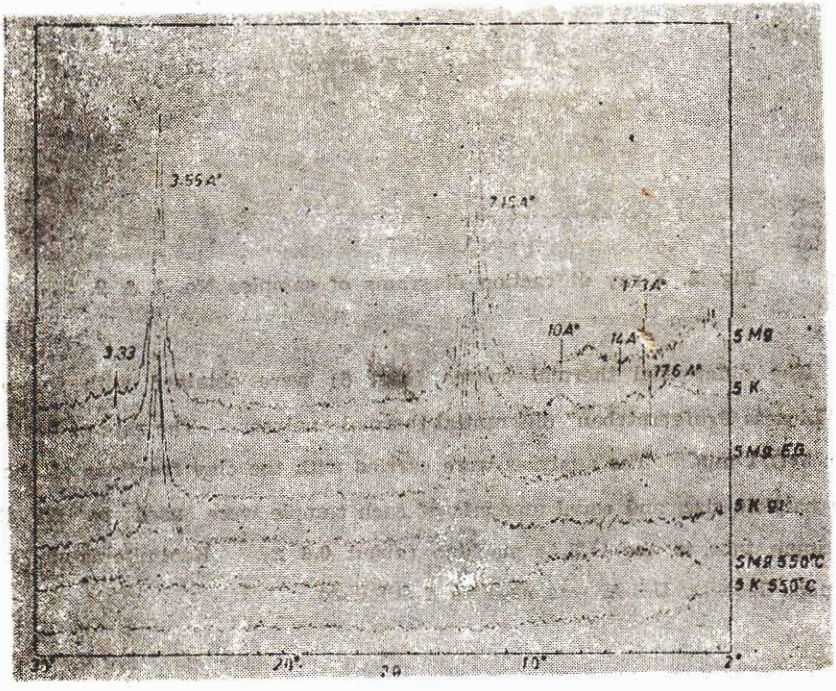

Fig. 5. X-ray diffraction diagram of sample No. 7.

Shape and size of the clay mineral particles: The fraction of clay samples of 2 u particle size was treated to remove the organic matter, then washed and mounted on a carbon coated grids for the electron microscope study. The electron micrographs (Figs. 7 & 8), were obtained with the use of Philips E.M. 200 electron microscope, magnification 23,000—30,000X, resolution 7A° and potential difference of 80 Kv (Table 2).

Texture: The texture of the clay samples was determined (Table 3) by the mechanical analyses (hydrometer method).

Exchangeable cations: The exchangeable cations were determined by subtracting the soluble in meq/100 g from the extractable (total) cations in meq/100 g (Table 4). The procedure followed was as described by Richards (1954).

Electrical conductivity (Ec): The Ec of the clay samples was measured with the Mullard Conductivity Bridge. The measurements were carried on the saturated pastes of the clay samples (Table 4).

Chemical analyses: Fe_2O_3 was determined volumetrically, TiO_2, MnO and P_2O_5 were determined colourimetrically as described by Groves (1951). The alkali metals were determined by the flame photometry, Ca and Mg by the Atomic Absorption Spectrophotometer Techtron A.A.4. Soluble and sulphide sulphur was determined according to Groves (1951). Carbon dioxide was taken as the loss on ignition after correcting for total water. Total water was determined by the Penfield method (Washington, 1930). Results obtained are given in Table 5.

Trace elements: Clay samples were decomposed with perchloric acid and hydrofluoric acid, and the trace elements Cu, Cr, Zn and Pb were determined by the Atomic Absorption Sectrophotometer Techtron A.A.4. Ba, Sr and Ni were determined by the X-ray Fluorescent Spectrometer (Table 6).

TABLE 2. Shape and size of the clay mineral particles.

Sample No.	Shape	Size (in u)	
		Smallest	Largest
1	Hexagonal	0.092	0.42
2	,,	0.19	0.61
3	,,	0.09	0.89
4	,,	0.25	1.1
5	,,	0.066	0.48
6	,,	0.093	0.36
7	,,	0.066	0.33
8	,,	0.066	0.49

TABLE 3. Mechanical separates.

Sample No.	% Sand	% Silt	% Clay	Texture
1	23.84	26.28	49.88	Clay
2	23.56	26.56	49.88	Clay
3	21.56	32.56	45.88	Clay
4	5.56	18.56	75.88	Clay
5	9.56	16.56	73.88	Clay
6	6.56	27.56	65.88	Clay
7	2.56	37.56	59.88	Clay
8	29.56	26.56	43.88	Clay

TABLE 4. Exchangeable Na, K, Ca and Mg and electrical conductivity (Ec).

Sample No.	Ec_{25} of saturated paste mmhos/cm	Saturation percentage	Soluble cations				Exchangeable cations				
			Na	K	Ca	Mg	Na	K	Ca	Mg	Total
			meq/100 g of soil				meq/100 g of soil				
1	4.2	72.2	3.37	0.05	2.31	1.29	0.47	0.33	10.91	2.14	13.85
2	3.35	70.5	2.72	0.06	1.89	1.18	0.91	0.46	15.53	2.00	18.90
3	1.65	63.3	1.39	0.02	0.48	0.37	0.45	0.15	4.39	2.38	7.37
4	1.6	64.3	1.71	0.02	6.43	6.38	2.74	0.79	7.79	5.39	16.71
5	3.1	74.1	4.89	0.04	0.71	1.04	1.90	0.30	11.94	5.81	19.95
6	2.18	77.0	2.58	0.02	0.36	0.40	1.62	0.29	7.96	3.85	13.72
7	1.80	93.8	2.53	0.03	0.32	0.27	2.40	0.78	5.38	5.38	13.89
8	1.35	68.5	1.6	0.01	0.19	0.19	1.40	0.59	3.41	3.71	9.11

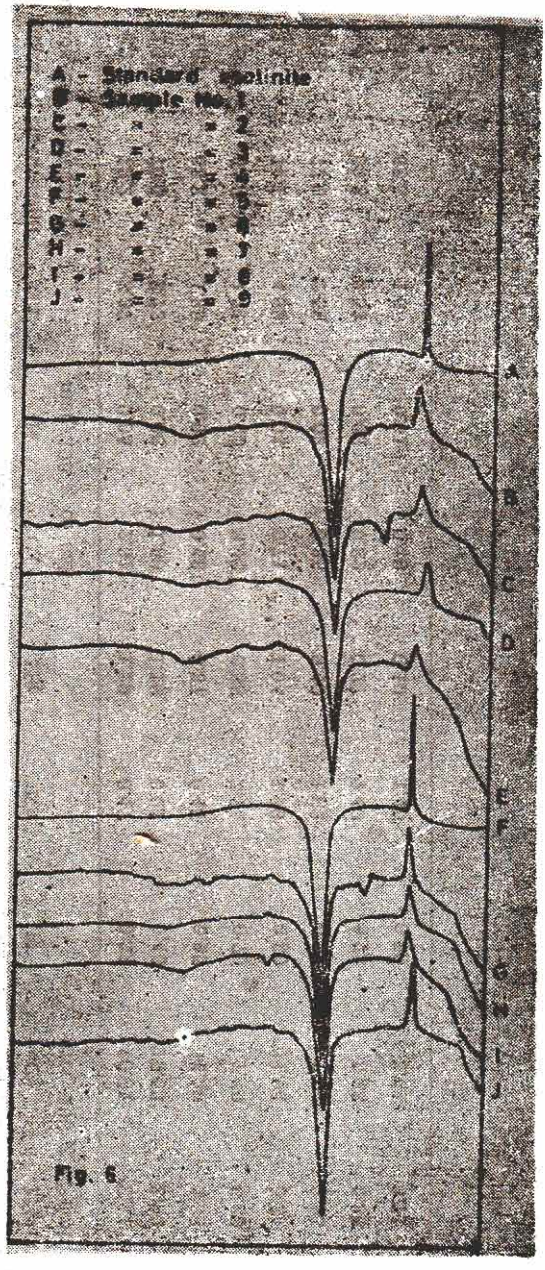

Fig. 6. Differential thermographs of samples No. 1—9.

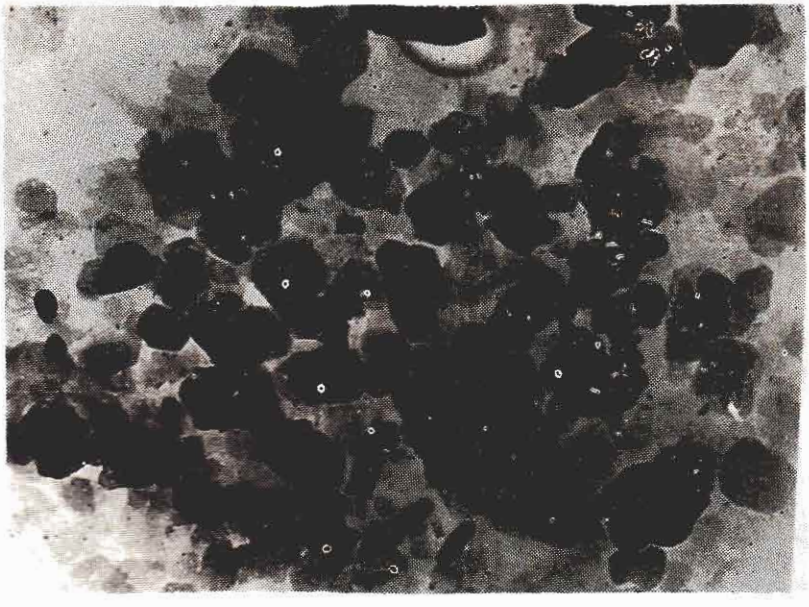

Fig. 7. Electron micrograph of sample No. 2.

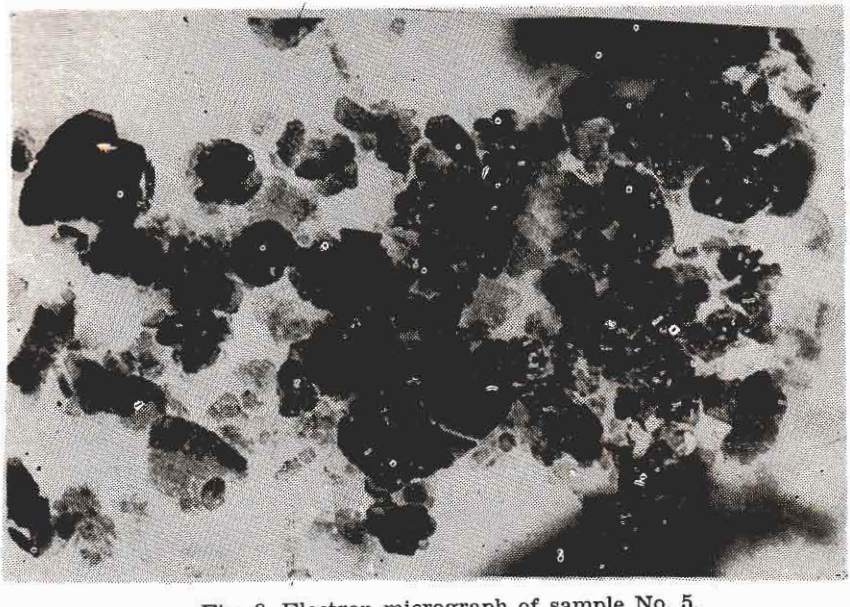

Fig. 8. Electron micrograph of sample No. 5.

TABLE 5. Chemical analyses (Elements in Percentages).

Elements	Samples							
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
Fe_2O_3	1.39	1.10	0.87	3.44	1.89	1.28	2.11	1.06
TiO_2	0.48	0.47	0.40	0.80	0.79	0.86	0.81	0.71
MnO	0.02	0.007	0.007	0.1	0.04	0.02	0.12	0.004
CaO	0.25	3.44	0.17	0.14	1.36	0.03	0.02	0.03
MgO	0.36	0.43	0.17	0.17	0.31	0.13	0.28	0.18
Na_2O	1.05	0.70	0.95	0.78	1.4	0.47	0.32	0.31
K_2O	0.7	0.8	0.42	1.46	0.52	0.28	0.73	0.53
H_2O+	8.97	8.39	8.73	8.97	10.5	12.09	10.87	9.4
H_2O^-	0.51	0.06	0.45	1.38	0.2	0.99	0.80	0.67
P_2O_5	0.029	0.051	0.029	0.1	0.048	0.046	0.064	0.068
CO_2	0.8	4	0.53	1.89	1.3	1.53	1.02	1
SO_3	n. d.	0.73	0.6	0.2	0.7	n. d.	0.1	n. d.
S^-	0.32	0.38	0.34	0.3	0.22	0.37	0.16	0.2

n. d. — Not detected.

RESULTS AND DISUSSION

Sample No. 1,3 & 4: These samples contained a high percentage of kaolinite (Fig. 3) as evidenced by the presence of very strong basal reflections of the first and second order at 7.15 and 3.55 A° respectively ,but these reflections disappeared upon heating the K and Mg saturated specimens to 550°C for 2 hours. In addition, samples No. 1 and 4 contained small amounts of impurities, such as, illite with basal reflections of the first and third order at 9.9—10 and 3.33 A°, and interstratified illite-montmorillonite (mixed-layer structures) as mainfested by the broad hump ranging from 9.9 to 14 A° in the Mg saturated and the small basal reflection at about 18 A° in the ethylene glycol saturated specimen. Sample No. 3 contained only traces of illite.

Sample No. 2: This sample contained the lowest percentage of kaolinite and in addition a small amount of impurities, such as, illite and illite-montmorillonite (mixed-layer structures).

Samples No. 5, 7 & 8: These samples contained the highest percentage of of kaolinite (Fig. 4 & 5), but in addition a considerable amount of impurities, such as, illite was present in samples No. 7 and 8. This was manifested by its first and third order reflections at 9.9—10 and 3.33 A° respectively. Sample No. 8 contained also a small amount of illlite-montmorillonite (mixed-

layer structures) as impurities. On the other hand, sample No. 5 contained only a small amount of illite as impurities.

The differential thermal curves (Fig. 6) of the clay samples were all similar to the mineral kaolinite (A) in which the endothermic and the exothermic reactions were very sharp. An approximate evaluation (sample No. 1, 58% kaolinite; No. 2, 44%; No. 3, 51%; No. 4, 55%; No. 5, 75%; No. 6, 60%; No. 7, 65%; and sample No. 8, 73% kaolinite) for the content of kaolinite in each sample was done following the method of Dean (1947) in which he relates the concentration to the trigonometric functions of the angle formed by extending the straight sides of the peaks. The angle is termed "angle α or peak angle".

The electron micrographs of the clay samples showed a six-sided flakes characteristic of kaolinite, some of them with prominent elongation in one direction (Figs. 7 & 8). From Table 2 it is obvious that the clay particles of samples taken from borehole No. 12 are finer in size than those samples taken from borehole No. 20. This could be due to the current velocity and the climatologic factors which might have played a role during the deposition of those clay sediments at that time.

From the previous discussion it follows that kaolinite is the predominant clay mineral in the samples. In addition, most of the samples contained a small to considerable amounts (samples No. 1 & 8) of illite and illite-montmorillonite (mixed layer structures) as impurities. This is in agreement with Al-Qaraghuli (1969) and Kuzvart and Urban (1970) who found that kaolinite is present in high amounts in the Triassic clay of Al-Ga'ara depression.

Texture: Particle size analyses (Table 2) of the components indicate that the term clay could be reserved for our samples, because the clay grade dominates.

Exchangeable cations: The range of the cation-exchange capacity* of the clay samples varies between 7.37 and 19.95 meq/100 g (Table 4). This low range is within the range of kaolinite clay mineral. The slightly higher capacity of samples No. 2 and 5 is probably due to the presence of gypsum. The range of cation exchange capacity for kaolinite is between 3 and 15 meq/100 g (Grim, 1962). The results of the Ec measurements (Table 4) indicate that the samples are nonsaline clays. They are classified as normal with respect to salinity, because the electrical conductivity of their saturation extracts is less than 4 mmhos/cm (Richards, 1954).

For ceramists a nonsaline clay (low soluble salt content) is desirable, but saline clay (high soluble salt content) are not, because on drying soluble salts contained by the clay tend to be carried to the surface where the evaporation of the water deposits them as a scum.

The nonsaline nature and the absence of fossils (see location and geology) in the clay samples are good evidence for a fresh water condition of sedimentation. From the structure point of view the lenticular forms of the sandstone deposits which are interdigitated with our clay deposits indicate typical stream channel forms. Furthermore, the cross-lamination found in the sand deposits indicates the delta basin condition (Vasiliev *et al.* 1963—1964).

The high content of kaolinite in the clay samples could be taken as a proof for fresh water condition of sedimentation. According to Oinuma and Kazuo (1966) the relationship between sedimentary formation and clay mineral composition shows that the compositions are characteristic of the depositional environments, for example, kaolinite is abundant in the formations deposited in fresh water, but its content is low in the formations deposited under marine environment.

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* For the purpose of discussion the sum of the exchangeable cations is considered as the cation-exchange capacity.

Major and trace elements analyses: Fe_2O_3, CaO, MgO, Na_2O and K_2O act as fluxes. They lower the fusion point of the clay, which is desirable for certain purposes, but is especially undesirable if the clay is to be used for refractory ware. It is clear from Table 5 that the sum of these oxides in clay samples is less than 5 percent, so we could say that their influence is negligible. Searle (1933) mentioned that only in the presence of large quantities (more than 5 percent of iron, alkalies, and alkaline earth) of fluxes there will be a pronounced effect on the lowering of the fusion point. Fe_2O_3 acts also as a colouring ingredient in clay, and the amount desired depends on the kind of the article and the colour needed in that industry.

TiO_2, MnO and P_2O_5 act as fluxes and as colouring agents in clays. Their contents in our clay samples (Table 5) is low and their effects could be neglected.

The amounts of soluble sulphate are low and vary between 0—0.73 percent, so it is most likely that there will be no tendency for scumming. The sulphide sulphur content is generally low, ranges from 0.16—0.38 percent and the formation of black coring during the burning is far from probable.

The amounts of the trace elements Cr (31—196 p. p. m.), Cu (20—58 p. p. m.), and Zn (29—46 p. p. m.) present in clay samples are generally low when compared with the amounts (410—680 p. p. m. Cr, 192 p. p. m. Cu and 80—230 p. p. m. Zn) mentioned by Rankama and Sahama (1960) for the Cr, Cu and Zn contents in clays.

The amounts mentioned in Tables 5 & 6 for P_2O_5 and Ni are lower than the average amounts of P_2O_5 and Ni (0.17% and 498 p. p. m.) in clays given by Clarke (1924).

On the other hand the contents of Ba (420—1000 p. p. m.) and Pb (29—50 p.p. m.) are high, if compared to the amounts (460 p. p. m. Ba and 16 p. p. m. Pb) given by Von Engelhardt's (1936) and Shaw (1954) for the average Ba and Pb contents in shales.

For the ceramists the effect of the trace elements Cr, Cu and Ni as colouring ingredients could be discarded because of their low contents in clay samples studied.

The trace elements could be taken as indicaters of provenance. The high contents of Ba and Pb and the low contents of P_2O_5, Cr, Cu and Zn indicate that the parent rocks could be acidic igneous rocks, and it is most likely the igneous rocks of the Arabian Shield. According to Rankama and Sahama (1960) acidic igneous are rich in Ba and Pb, but poor in P_2O_5, Cr, Cu and Zn.

CONCLUSIONS

From the X-ray, D.T.A., and the eleytron micrоscope studies it is obvious that kaolinite is the predominant clay mineral in clay samples studied. The amounts of kaolinite in the samples taken from borehole No. 12 are high (range from 75 percent to 60 percent) in the samples taken from borehole No. 20 lower (range from 58 to 44%). The amounts of other clay minerals, which are present as impurities, vary from traces as in samples No. 5 & 6 to considerable amounts as in samples No. 7 & 8. Clay samples from borehole No. 12 have a finer clay particle size than samples from borehole No. 20.

TABLE 6. Trace elements in p. p. m.

Sample No.	Sr	Ba	Cr	Cu	Zn	Pb	Ni
1	18	900	31	22	35	30.1	<10 than 10 p.p.m.
2	20	480	120	50	46	32.5	<10 than 10 p.p.m.
3	10	420	50	20	360	40	<10 than 10 p.p.m.
4	20	1000	146	58	42.8	36.5	12 p.p.m.
5	12	1000	132	30	40	29	<10 than 10 p.p.m.
6	25	800	116	30	29.2	39	10 p.p.m.
7	21	700	196	38	40	43	10 p.p.m.
8	85	880	118	24	32.8	43	10 p.p.m.

The Triassic clays of Al-Ga'ara depression were deposited under fresh water conditions.

Acidic igneous rocks of the Arabian Shield, after their deep weathering served as a most probable source material, as proved by geological and geochemical data described above.

I greatly appreciate the help of the National Mineral Company for supplying the clay samples with the maps and the geological information of the area.

I thank Dr. Nadheema Kaddouri, former director of the Institute for Research on Natural Resources, for providing the facilities necessary for preparing the clay samples, and granting permission for using the Atomic Absorption Spectrophotometer. I am also indebted to Mr. S. M. Salih, Biological Research Center, Electron Microscope Unit, for helping me in obtaining the electron micrographs.

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WINTER FODDER MIXTURE TRIALS IN IRAQ

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SUMMARY

Berseem clover (*Trifolium alexandrinum* L.), horsebean (*Vicia faba* L.), barley (*Hordeum vulgare* L.), and oats (*Avena sativa* L.) were sown separately and as a grass-legume fodder mixture by applying the randomized complete block design with four replications. The trials were conducted at Abu-Ghraib Irrigated Station, College of Agriculture, University of Baghdad for 3 years. The fodder yield, leaf to stem ratio, grass to legume ratio and weed percentage were studied and analysed statistically.

The barley + berseem, oats + berseem fodder mixtures and berseem fodder were significantly the highest in fodder yield, the other fodder treatments produced low yield.

Cats + horsebean fodder mixture was significantly the leading in leaf to stem ratio and grass to legume ratio.

Barley fodder was significantly the highest in weed percentage and oats + berseem fodder mixture was the lowest.

The fodder mixtures competed with weeds better than any of the fodder crops alone.

It is recommended to use barley + berseem fodder winter mixture at a rate of 60 and 24 Kg seed/ha respectively.

الخلاصـــة

زرعت محاصيل العلف الشتوية المكونة من البرسيم (*Trifolium alexandrinum* L.) والبـــاقلاء (*Vicia faba* L.) والشـــعير (*Hordeum vulgare* L.) والشـــوفان (*Avena sativa* L.) بصورة فردية او كخليط من الحشيش والبقول بتطبيق تصميم القوالب العشوائية الكامل باربعة مكررات ·

كان موقع التجربة في محطة ابي غريب الاروائية بكلية الزراعة ـ جامعة بغداد ومدتها (٣) سنوات ٦٦ـ١٩٦٧ ، ٦٧ـ١٩٦٨ ، ٦٨ـ١٩٦٩ · درس حاصل العلف ، نسبة الاوراق للساق ونسبة الحشيش الى البقول ونسبة الادغال المئوية وحللت احصائيا ، وقد حصل على النتائج التالية :ـ

كانت مخاليط الشعير + البرسيم ، الشوفان + البرسيم العلفي والبرسيم العلفي هي الاعلى في حاصل العلف معنويا ، انتجت بقية المعاملات العلفية حاصل واطىء ·

كان خليط الشوفان + الباقلاء العلفي هو المتفوق معنويا في نسبة الاوراق الى الساق ونسبة الحشيش الى البقول ·

كان الشعير العلفي هو الاعلى معنويا في نسبة الادغال المئوية وكان خليط الشوفان + البرسيم العلفي هو الاوطأ فيها ·

نافست المخاليط العلفية الادغال بصورة افضل من كل المحاصيل العلفية منفردة ·

يوصي باستعمال خليط الشعير + البرسيم العلفي الشتوى بمعدل ٦٠ ، ٢٤ كغم حبوب/هكتار على التوالي ·

INTRODUCTION

The only winter grass-legume fodder mixture used by farmers in Iraq is barley and horsebean. El-Shamma (1966) showed that both berseem and oats are very promising winter fodders in comparison to horsebean and barley.

The objective of this study was to compare berseem as a winter fodder mixture with oats or barley and the winter fodder mixture of horsebean with barely or oats, and to find the most suitable grass and legume winter fodder mixture.

The use of berseem as fodder mixture with barley or oats was not found in the literature. But a rather wide study was reported on alfalfa and some clovers as fodder mixtures with some grasses. Thatcher *et al.* (1937) in Ohio found alfalfa and timothy as a good fodder mixture. But Lute (1937) in Michigan concluded that alfalfa and brome grass were best competitors and recommended to be used as a fodder mixture. Mc Kee and Schotch (1934) stated that vetch and small grains (wheat, barley and oats) are the most suitable fodder mixtures. According to Willard *et al.* (1948) in Ohio, alfalfa, red clover, ladino white clover and timothy are the best fodder mixtures. Jones and Brown (1947) in California and Scotch (1944) in Oregon recommended ladino white clover, tall fescue, rye and orchard grass to be used as a fodder mixture.

MATERIALS AND METHODS

Berseem clover (*Trifolium alexandrinum* L.), horsebean (*Vicia faba* L.), barley (*Hordeum vulgare* L.), and oats (*Avena sativa* L.) were sown separately at the rate of 32, 120, 100 and 100 Kg seed ha, respectively. The berseem barley and berseem oats fodder mixtures were sown at a rate of 24 : 60 Kg seed/ha respectively, but the horsebean barley and horsebean oats fodder mixures were sown at a rate of 80:60 Kg seed/ha, respectively. Each of the mentioned treatments was sown by the broad-casting method at a plot 5m long and 2m wide by applying the randomized complete block design with four replications. The experiment was conducted at the Irrigated Station, College of Agriculture, University of Baghdad in Abu-Ghraib. The soil was virgin clay loam. The duration of the experiment was three years (1966 through 1969). The trials had been conducted in the same field in all years. The date of seeding was in the second week of October each season and date for

obtaining the final fodder cuttings was about the end of May each year. The plots were given about 7, 6 and 5 irrigations and nowed 1, 1 and 3 times during the fall, winter and spring each year, respectively. The plants in each plot were mowed when plants reached a height of 40—50 cm during the fall, winter and at 20% flowering in the spring. About 5—6 cm of the lower stems were left uncut to encourage regrowth of the plants.

An area of 50 X 50 cm in each plot was selected at random for studying leaf to stem ratio, grass to legume ratio and weed percentage. The fodder yield was cut from each plot, weighed and converted into tons/ha. All data were statistically analysed.

RESULTS AND DISCUSSION

Before interpreting the results, it should be mentioned that there was a significant variation among the various fodder treatments for each trait studied, with rather similar trend each year. The results mentioned below were based on three year averages:

Fodder yield tons/ha. The variation among treatments was significant ($p < 0.01$). The barley + berseem, oats + berseem fodder mixtures and berseem fodder were the highest yielders (Table 1). The range of the fodder yield was from 9.54 to 27.48 Kg/ha.

Leaf to stem ratio. The analysis of variance indicated a significant difference among treatments ($p < 0.01$). Oats + berseem, horsebean followed by barley + horsemean and oats + berseem fodders were the leading in this trait (Table 1). The range of the leaf to stem ratio was from 35.21 to 58.07.

Grass to legume ratio. Table 1 shows that oats + horsebean fodder mixture was the highest ($p < 0.01$) and oats + berseem was the lowest, they produced 52.87 and 35.00 grass to legume ratio, respectively.

Weed percentage. There was a significant variation among the fodder

treatments ($p < 0.01$). Barley fodder was the highest in weed percentage and oats + berseem fodder mixture was the lowest (Table 1).

The data indicated clearly the difficulty in obtaining the highest fodder yield from any of the fodder mixture with the highest leaf to stem ratio. However, oats + berseem fodder mixture which was among the highest in fodder yield was also among the highest in leaf to stem ratio. Oats + horsebean fodder mixture which was very low in fodder yield was the leading in both leaf to stem ratio and grass to legume ratio. The barley, barley +horsebean fodders which were the lowest in fodder yield were the highest in weed percentage. Thus the increase in weed percentage may cause severe decrease in fodder yield. The fodder mixtures had better competitor with weeds than each of the fodder alone.

TABLE 1. Average fodder yield tons/ha, leaf to stem ratio, grass to legume ratio and weed percentage in 1967, 1968 and 1969.

Treatments		Fodder yield tons/ha	Leaf to stem ratio	Grass to legume	Weed percentage
Barley		9.65	35.21	—	45.97**
Barley + horsebean		9.84	52.01*	42.97	26.27
Barley + berseem		27.48**	39.84	36.45	14.26
Oats		13.83	48.40	—	17.35
Oats + horsebean		12.85	58.07**	52.87**	13.74
Oats + berseem		25.58**	51.96*	35.00	9.91
Horsebean		9.54	55.84**	—	29.97
Berseem		26.87	43.00	—	17.75
L.S.D.	5%	3.89	5.93	6.06	10.71
	1%	5.49	8.07	8.71	14.57

* $P < 0.05$.

** $P < 0.01$.

Similar studies in which berseem was used as a mixture with other grasses is not reported in the literature. Our study indicated that barley + berseem fodder mixture are the most suitable and recommended to be used by the farmer in the middle irrigated region. The soil used should be slightly saline since berseem did not tolerate medium or heavy amounts of salt. Berseem is also very sensitive to cold, thus any delay beyond the third week of October may cause severe damage to the plants, unless they are 30 cm high or more.

The study of fodder mixtures is very tedious. It requires continuous work in the field, careful observation and efficient records. Grasses usually grow quicker than legumes, thus it was not possible to balance between the mixtures of these fodders before mowing, especially during the fall and winter where mowing was made when any of the fodder was 40—50 cm high. Similar difficulty was found during flowering 20% in the spring, due to unbalance flowering of the grass and legume mixtures.

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THE EFFECTS OF TIME AND RATE OF NITROGEN APPLICATION ON GROWTH AND YIELD OF WHEAT. (TRITICUM AESTIVUM L.)

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(Revised M S received 24 April 1976)

SUMMARY

Pot experiment was conducted at the College of Agriculture, Abu-Ghraib, in a wire cage to study the effects of rate and time of nitrogen application on the growth and yield of the three spring wheat varieties, Maxipak, Maxican 24 and Ajeba.

Three levels of nitrogen were used namely 0, 200 and 300 ppm N (dry basis). The nitrogen was added as ammonium sulphate solution as follows:

Single: All nitrogen was added at sowing time.

Split—2: Half of the nitrogen in each level was added at the time of planting and the other half 45 days after sowing (at tellering stage).

Split—3: One-third of N was applied at the time of planting, one-third at tellering stage as above, and one-third at ear initiation stage (20 days before heading).

A split plot design was used with three replications.

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Grain yield, TDM and root weight were significantly increased with nitrogen application for all varieties and time of application.

There was a significant increase in yield and TDM at higher rate of N application. The weight of roots at the flowering stage did not respond to higher levels of nitrogen.

Significant differences were found between Ajeba and the Maxican varieties in TDM and roots weight but not in yield.

Significant differences were found between Maxipak and Maxican 24 in yield and TDM.

There was a significant interaction between variety and time of application of nitrogen, but generally split—2 gave the best result.

It was concluded that: a) in the soil used nitrogen fertilizers are necessary to increase the yield of wheat, b) the effect of time of N application differed with different varieties, but generally dividing the nitrogen into two parts, one-half added at sowing time and the other half at tellering stage was the best, and c) that the Maxican varieties are more efficient in storing a greater fraction of their total dry matter in grains at the late stages of growth than the adapted tall variety giving a high ear/straw ratio.

الخلاصـــة

زرعت ثلاثة اصناف من الحنطة هى مكسيكي ٢٤ M ومكسيباك MP وعجيبـة A في أصص تحت الظروف الطبيعية في كلية الزراعة بأبي غريب لغرض المقارنة لمدى استجابة الاصناف المكسيكية مع الصنف المحلى (عجيبة) ، وكذلك مقارنة تأثير وقت اضافة السماد النايتروجيني على حاصل ونمو النبات ٠

استعملت لهذا الغرض تربة مزيجة طينية من حقل الكليـــة في العامرية وبمقدار ٤ كغم تربة جافة لكل سندانة ٠ وقد استعملت ثلاث مستويات مـــن النايتروجين هي : صفر ، ٢٠٠ ، ٣٠٠ جزء بالمليون نايتروجين على صورة سلفات

الامونيوم · وقد اضيفت هذه المستويات من النايتروجين بشكل محلول وعلى ثلاث حالات أو أوقات لكل مستوى على الصورة التالية :ـ

الاول : كل النايتروجين في كل مستوى أضيف قبل الزراعة ·

الثاني : أضيف نصف كمية النايتروجين في كل مستوى قبل الزراعة والنصف الثانى ٤٥ يوما بعد الزراعة (أى في مرحلة التفرع) ·

الثالث : في الوضعية الثالثة قسمت كمية النايتروجين في كل مستوى الى ثلاثة أقسام متساوية ، أضيف ثلث الكمية وقت الزراعة والثلث الآخر ٤٥ يوما بعد الزراعة والثلث الاخير أضيف في مرحلة تكون السنابل (٢٠ يوما قبل الازهار) ·

صممت التجربة على أساس الالواح المنشقة · حصدت النباتات وأخذ وزن الحاصل والوزن الجاف للنباتات وسجلت مكونات الحاصل · وحللت النتائج احصائيا ·

دلت النتائج على ما يلى :ـ

١ ـ وجود فرق احصائي ذو مغزى على مستوى ١٪ بالنسبة للحاصل وكذلك بالنسبة للوزن الجاف ووزن الجذور عند الازهار بين المعاملات المسمدة وغير المسمدة لجميع الاصناف ولجميع أوقات الاضافة لنايتروجين ·

٢ ـ وجود فرق احصائي ذو مغزى على مستوى ١٪ بين مستويات النايتروجين المستعملة بالنسبة للحاصل والوزن الجاف وعدم وجوده بالنسبة لوزن الجذور عند الازهار ·

٣ ـ وجود فارق احصائي ذو مغزى على مستوى ١٪ بين العجيبة والاصناف المكسيكية بالنسبة للوزن الجاف للنبات ووزن الجذور عند الازهار وعدم وجود فرق احصائي بالنسبة للحاصل ·

٤ ـ وجود فارق احصائي ذو مغزى على مستوى ١٪ بين الصنفين مكسيباك ومكسيكي ٢٤ سواء كان ذلك بالنسبة للحاصل أو الوزن الجاف للنبات ·

٥ ـ وجود تداخل بين نوع الحنطة وطريقة اضافة النايتروجين ، حيث تاثرت الاصناف المستعملة تأثرا مختلفا بطريقة الاضافة · لكن بصورة عامة اضافة النايتروجين على دفعتين اعطى احسن النتائج ·

٦ ـ ان الاصناف المكسيكية لها قابلية على خزن نسبة مهمة من الوزن الجاف في البذور في المراحل الاخيرة من النمو اكثر مما في الصنف المحلى (العجيبة) ·

INTRODUCTION

The semi-dwarf Maxican varieties of wheat are known to be highly responsive to Introgen application (Amin, 1968; and Hassan and Al-Sabti, 1973). The authors, in an NPK fertilizer experiment on wheat, did not find any response to the basal application of nitrogen fertilizer (Al-Rawi and Samarrai, 1973). This was attributed to the loses of nitrogen before the plant can benefit from it. There are evidence that split application of nitrogen gives higher yield than single application at time of planting (Hamid, 1972; and Hassan and Al-Sabti, 1973).

The object of this work is to study the effect of time and rate of nitrogen application on the growth and yield of three wheat varieties.

MATERIALS AND METHODS

Three spring wheat varieties, Maxipak, Maxican 24, and Ajeba refered to as MP, M 24, and A respectively in this work, were grown in pots 19 cm in diameter at the top, 15 cm at the botton and 18 cm deep. Four kilograms of soil (oven dry basis), were packed in each pot. The soil was collected from the plow-layer of a sight in Ameriyah Expteriment Station, Abu-Ghraib. Some of the characteristics of the soil are shown in Table 1. Three plants were maintained in each pot. Three levels of nitrogen were used namely 0, 200, and 300 ppm (dry basis). The nitrogen was added as ammonium sulphate solution at the following times of application for each level of nitrogen used:—

(i) Single: All nitrogen was added at the planting time.

(ii) Split—2: Half of the amount of nitrogen in each level was added at the time of planting and the other half 45 after sowing (at tellering stage).

(iii) Split—3: The amount of nitrogen in each level was divided into three equal parts.

ABLE 1. Some characteristics of the soil used.

turated paste extract		Soluble ions m.e./l								% of dry soil		Exchangeable cations m.e./100 g			
C	pH	Ca	Mg	Na	K	Cl	SO_4	CO_3	HCO_3	O.M.	N	CEC	(Ca+Mg)	Na	K
0	7.8	7.2	5.1	2.2	0.1	10.0	4.0	—	0.6	1.5	0.1	24.8	23.5	0.4	0.9

One-third was applied at the time of planting, the other third at tellering stage as above, the remaining third at the ear initiation stage (20 days before heading).

The experiment included the following treatments:—

Treatment 1 = No nitrogen addition.

Theatments 2, 3 and 4 = 200 ppm N added as single, split—2 and split—3 respectively.

Treatments 5, 6 and 7 = 300 ppm N added as single, split—2 and split—3 respectively.

A split-plot design was used with three replications. Each treatment consisted of 6 pots. All treatments received equal amounts of phosphorus and potassium added at the planting time. The sowing date was 15 November.

At the flowering stage 3 pots from each treatment were taken and the plants were separated into roots, shoots and heads, dried at 70°C and weighed. The other three were kept until maturity.

At maturity the plants were harvested, the yield and yield components were recorded and data was statistically analyzed.

RESULTS AND DISCUSSION

Table 2 and Figure 1 show the effect of different treatments on grain yield of the three varieties of wheat used. It can be seen that there was a highly significant increase in grain yield with increasing amount of nitrogen in all varieties and under all times of applications. The increase in grain yield with nitrogen addition was accompanied with an increase in plant height, number of spikes, number of kernels per spike and spike weight (Table 3). Partridge and Shaykewich (1972) and Hassan and Al-Sabti (1973), have reported that nitrogen increases the vegetative growth of plants and the

TABLE 2. Effect of rate and time of application of ammonium sulfate on the grain yield of three wheat varieties (g/pot).

Treatment No.	N level ppm	Time of application	Variety A	MP	M24	Total	Mean
1	0		14.6	13.0	11.7	39.3	13.10
2	200	single	45.7	51.0	54.1	150.8	50.27
3		split—2	56.8	48.7	53.6	159.1	53.03
4		split—3	55.6	50.1	54.6	160.3	53.43
5	300	single	56.4	61.9	60.3	178.6	59.53
6		split—2	62.5	58.6	78.4	199.5	66.50
7		split—3	60.8	53.9	76.3	191.0	63.67
Total			352.4	337.2	389.0		
Mean			50.34	48.71	55.57		

	0.05	0.01
L.S.D. for treatment means	2.806	3.933
L.S.D. for variety means	0.991	1.337
L.S.D. for treatment X variety	2.623	3.538

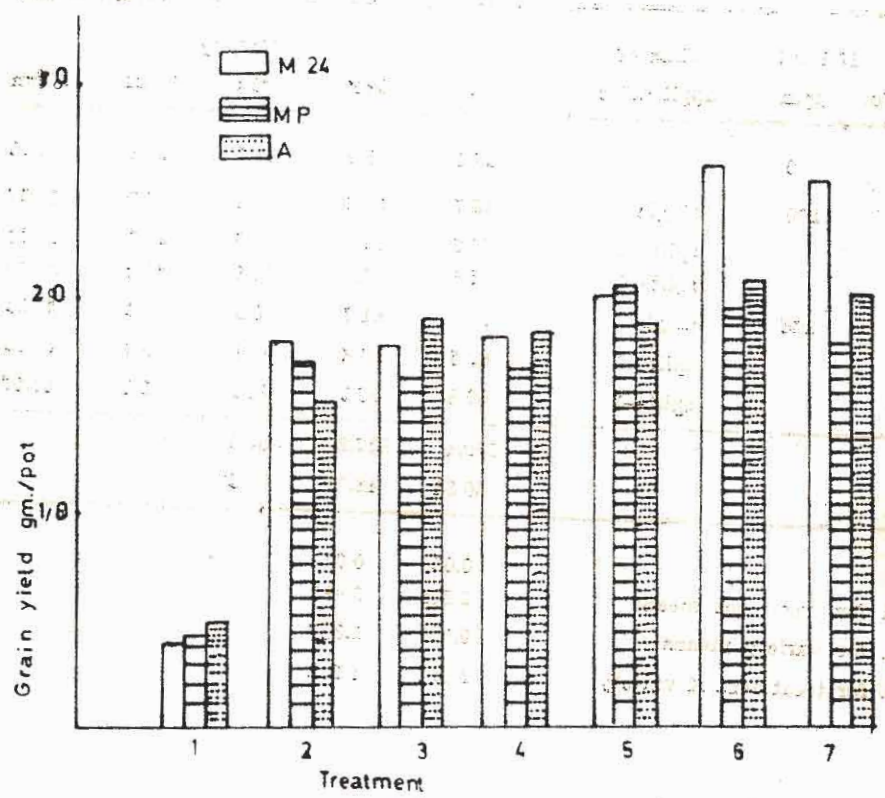

Fig. 1. Effect of time and rate of nitrogen application on grain yield of wheat

TABLE 3. Effect of time and rate of nitrogen application on the yield components of three varieties of wheat.

Variety	Treatments	Plant height (cm)	Spike wt. (g)	Wt. of 100 grains (g)	No. of spikes per pot	No. of kernals per spike	Ear/straw ratio
Ajeba	1	24	7.5	27.8	8	1.6	0.85
	2	82	32.6	27.2	20	6.1	0.85
	3	91	28.3	28.9	22	7.6	0.93
	4	79	29.2	30.1	21	7.2	1.13
	5	79	28.6	27.5	24	7.0	1.05
	6	82	31.4	28.6	26	8.5	1.07
	7	80	30.6	26.4	23	7.0	1.16
	Mean	81.0	25.6	28.1	20.6	6.4	1.016
Maxipak	1	64	6.3	29.3	4	1.7	0.87
	2	73	24.4	39.4	12	7.0	1.01
	3	76	25.6	28.3	13	8.1	1.00
	4	72	24.5	25.8	10	7.4	1.16
	5	75	30.8	26.6	14	10.2	1.20
	6	71	30.0	26.0	14	9.3	1.10
	7	76	28.2	22.2	11	9.7	1.16
	Mean	72.4	24.2	26.4	11.14	7.8	1.071
Maxican 24	1	62	5.7	28.0	6	1.4	0.83
	2	77	25.0	32.2	14	6.5	1.13
	3	73	26.2	32.8	15	6.9	1.13
	4	72	25.4	33.6	13	5.7	1.23
	5	79	29.3	31.3	16	7.8	1.18
	6	75	37.1	36.5	19	8.2	1.28
	7	73	34.2	36.9	15	7.3	1.34
	Mean	73.0	26.1	33.0	14.0	6.3	1.16

photosynthetic area thus increases the building up of plant tissue.

There were highly significant differences in grain yield between varieties used. M24 gave the highest grain yield (Fig. 1). When Ajeba was compared with the two Maxican varieties, no significant differences were obtained. However, M24 gave significantly higher yield than MP. This was reflected in high kernel weight, high number of spikes and high ear/staw ratio (Table 3, Fig. 3 & 4).

Where was a highly significant interaction between variety and time of nitrogen application. With Ajeba there was a significant increase in grain yield when nitrogen was splitted into two parts (Split—2) and no significant reduction when added as split—3 under all levels of nitrogen used. With MP, there was no significant difference in grain yield with time of application at the relatively low level of nitrogen (200 ppm). At the relatively higher level of nitrogen (300 ppm N) however, there was a significant decrease in grain yield when nitrogen was added as split—2 and a high significant reduction when it was added as in split—3. With M24 variety, no significant difference was found in grain yield between methods of application at the relatively low nitrogen level, while, there was a highly significant increase when the relatively high level of N was added as split—2 and no significant reduction when it was added as split—3. These results show that varieties differ in their response to the time of N application and that for each variety time of application differs with N level used. In general, splitting nitrogen into two parts, one-half added at the sowing time and the other half at the tellering stage gave the best results. This may be due to the more efficient use of added nitrogen at the tellering stage when nitrogen is mostly needed.

When all the nitrogen was added at the sowing time, there would be an excess of N in the soil, since the plant is too small to use; therefore some of the added N may be lost before the plant can use it. The reduction in yield

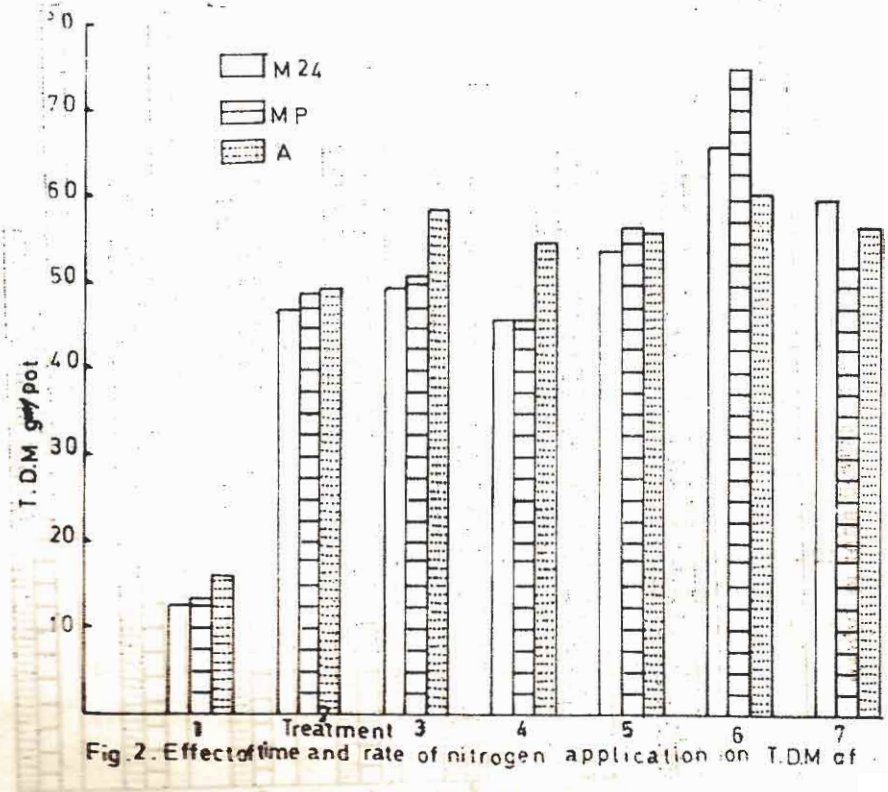

Fig. 2. Effect of time and rate of nitrogen application on T.D.M of wheat.

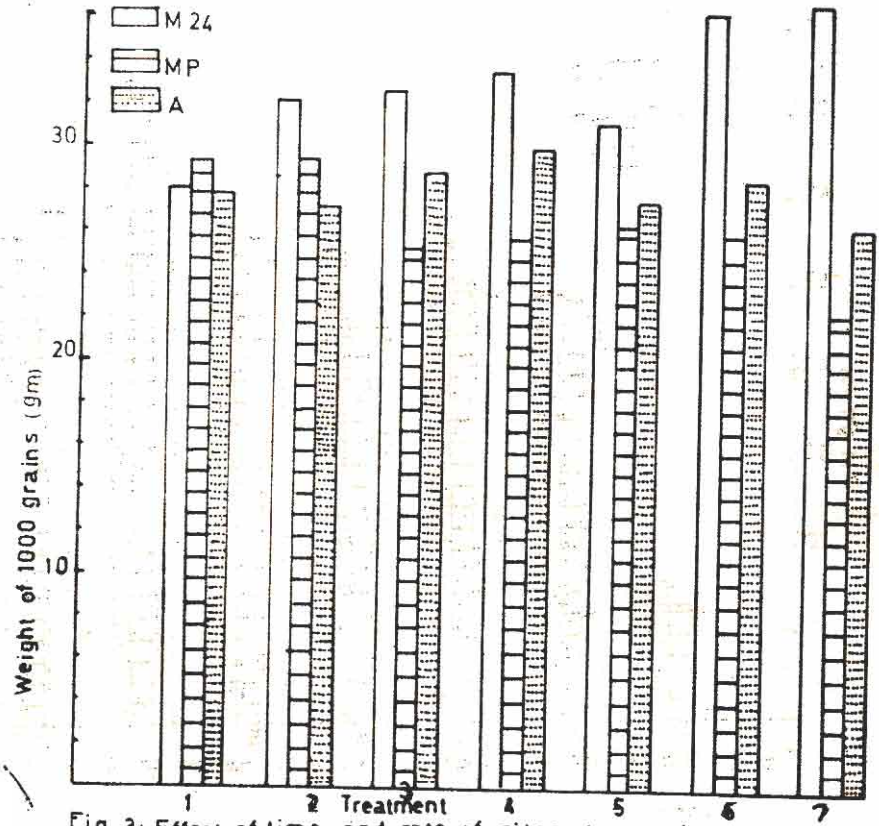

Fig. 3: Effect of time and rate of nitrogen application on the weight of 1000 grains

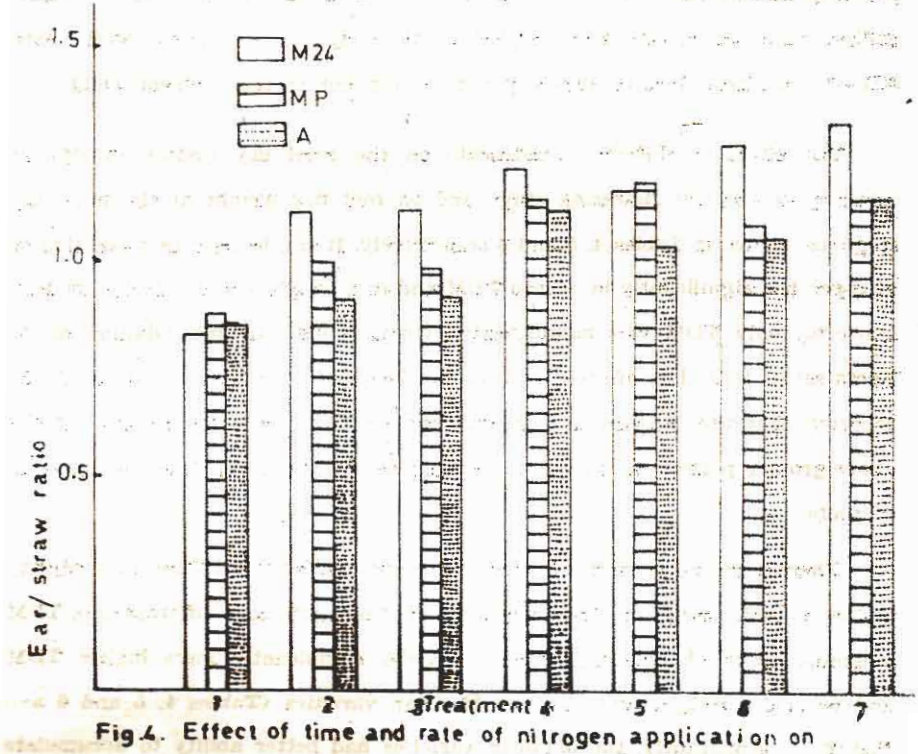

Fig.4. Effect of time and rate of nitrogen application on ear/straw ratio

when nitrogen was split into three parts may be due to low nitrogen assimilation rate (NAR) by the plant at the later stages of growth. Khalifa (1973) studied the effect of nitrogen on NAR and yield of wheat, and found that all treatments received N showed an increase in NAR, but only N added at tellering was significant. Hassan and Al-Sabti (1973) found that split application of N gave higher yield of wheat than single application at time of planting. Hamid (1972) reported that at the rate of 120 Kg N/ha NO_3—N was utilised most effectively when added at three split applications, while with NH_4—N, splitting beyond two applications did not increase wheat yield.

The effect of different treatments on the total dry matter (TDM) at maturity and at the flowering stage and on root dry weight at the flowering stage are shown in Tables 4, 5 and 6 respectively. It can be seen that addition of nitrogen has significantly increased TDM and root weight relative to the control. However, only TDM was significantly increased with further addition of N. Roots seems to be less affected with higher levels of N addition. Black (1968) reported that the increase in the nitrogen supply causes the growth of the above-ground portion of plants to increase relatively more than the growth of roots.

There were significant differences between varieties in TDM at maturity and in roots dry weight at flowering stage, but no significant differences in TDM including roots at flowering stage. Ajeba significantly gave higher TDM and roots dry weight than the two Maxican varieties (Tables 4, 5 and 6 and Fig. 2). Apparantly, the Maxican varieties had better ability to accumulate more proportion of dry matter in the ears at the late stage of growth than Ajeba, giving a high ear/straw ratio and heavier kernel weight (Fig. 3 and 4). Similar findings were reported by other workers (Vogel *et al.*, 1956; McNeal *et al.*, 1960; Syme, 1967; and Thorne *et al.*, 1969).

Significant interaction was observed between variety and treatment concerning TDM and roots weight. However, similar to the results with the grain yield data, each variety responded differently to the different treatments.

TABLE 4. Effect of rate and time of application of ammonium sulfate on total dry matter of three wheat varieties at time of harvest (roots are not included) (g/pot).

Treatment No.	N level ppm	Time of application	Variety A	MP	M24	Total	Mean
1	0		47.9	40.4	37.7	126.0	42.00
2	200	single	148.2	146.4	141.4	346.0	145.33
3		single	175.9	153.2	148.1	477.2	159.06
4		split—3	165.5	137.0	138.0	441.0	147.00
5	300	single	167.8	169.5	162.3	499.6	166.53
6		split—2	182.1	171.4	198.0	551.5	183.83
7		split—3	170.6	157.7	179.0	507.3	169.10
Total			1058.0	975	1005.0		
Mean			151.4	139.37	143.57		

	0.05	0.01
L.S.D. for treatment means =	3.704	5.193
L.S.D. for variety means =	3.575	4.823
L.S.D. treatment variety =	9.467	12.760

TABLE 5. Effect of rate and time of application of amm. sulfate on total dry matter of three wheat varieties at flowering stage (roots are included). (g/pot)

Treatment No.	N level ppm	Time of application	Variety A	MP	M24	Total	Mean
1	0		46.6	44.8	43.6	135.0	45.00
2	200	single	142.9	140.3	137.6	420.8	140.27
3		split—2	160.6	161.6	148.8	471.0	157.00
4		split—3	168.3	135.5	126.9	430.7	143.57
5	300	single	162.5	177.0	164.3	503.8	167.93
6		split—2	166.8	164.7	168.6	500.1	166.70
7		split—3	151.6	173.2	149.2	474.0	158.00
Total			999.3	997.1	939.0		
Mean			142.75	142.44	134.14		

	0.05	0.01
L.S.D. for treatment means =	2.946	4.129
L.S.D. for variety means =	4.711	6.356
L.S.D. for treatment X variety =	12.465	16.817

TABLE 6. Effect of rate and time of application of ammonium sulfate on roots dry weight of three wheat varieties at the flowering stage (g/pot).

Treatment No.	N level ppm	Time of application	Variety A	MP	M24	Total	Mean
1	0		13.52	10.05	12.28	35.85	11.95
2	200	single	28.65	25.59	26.71	80.95	26.98
3		split—2	26.58	30.81	24.52	81.91	27.30
4		split—3	31.44	16.22	18.54	66.20	22.06
5	300	single	24.31	21.32	24.44	70.07	23.35
6		split—2	30.99	22.53	26.56	80.08	26.69
7		split—3	27.45	32.09	24.79	84.33	28.11
Total			182.94	158.61	157.84		
Mean			26.31	22.65	22.55		

	0.05	0.01
L.S.D. for treatment means =	1.442	2.021
L.S.D. for variety means =	0.925	1.247
L.S.D. for treatment variety =	2.446	3.300

Generally all varieties gave the highest TDM and roots weight at the higher nitrogen level when it was splitted into two parts.

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STUDIES OF PLANTS SPACING AND NUMBER OF PLANTS PER HILL IN MANCHURIAN JUTE

(Abutilon avicinae)

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(Received 22 February 1976)

SUMMARY

An experiment on a Manchurian Jute variety was carried out during three growing seasons (1959—1961). The main objective of the study was to determine the effect of spacing between plants within rows and number of plants per hill on yield of stems and fibers. A split plot design was used with four replications. Three spacings between hills, namely 0, 20 and 30 cm were used as main plots and four numbers of plants per hill, 2, 3, 4 and 5 were used as subplots.

There was no sifinificant difference among treatments in both stem and fiber yields in 1959 and 1960. However, there was a highly positive correlation between stem diameter and plant height, and a significant negative correlation between plant height and fiber percentage ($r = -0.570$). The correlation between stem diameter and fiber percentage was not significant. The last two correlations indicated that closer spacing gave better yield of fibers.

In 1961, 10cm spacing between rows was superior in both yield and fibers. It seems that narrow spacing of 10 cm along with four plants per hill was the best with regard to yield of both stems and fibers per unit area.

الخلاصـــــة

تم دراسة صنف جوت منشورى مستورد من مصر عام ١٩٤٤ من حيث أثر المسافات بين الجور بالخطوط وعدد النباتات بالجورة · استعمل في ذلك تصميم الالواح المنشقة بأربع مكررات وكانت المسافات بين الجور هي : ١٠ و ٢٠ و ٣٠سم في الالواح الرئيسة وعدد النباتات في الجورة هى ٢ و ٣ و ٤ و ٥ في الالواح الثانوية · طبقت التجربة لثلاث سنوات (١٩٥٩ـ١٩٦١) · درس حاصل السيقان والالياف وحللت احصائيا وتم الحصول على النتائج التالية :ـ

لم يحصل تفوق لاى من المعاملات من حيث حاصل السيقان أو الالياف لعام ١٩٥٩ ولكن وجدت علاقة موجبة بين قطر الساق وارتفاعه على مستوى عال · كما وجدت علاقة سالبة بين النسبة المئوية للالياف وكل من ارتفاع النباتات وقطر الساق وعلى هذا الاساس فأن اتباع المسافات الضيقة عند الزراعة يعطي نسبه ألياف عاليه ·

لم يكن هناك تفوق لاى من المعاملات في عام ١٩٦٠ كذلك ·

في عام ١٩٦١ ظهر من نتيجة التحليل الاحصائي بأن المسافة ١٠ سم متفوقة على المعاملتين الاخريين وعليه يمكن الاستنتاج بأن المسافات الضيقة بمقدار ١٠سم بين الخطوط مع أربع نباتات بالجوزة لتعطي أفضل انتاج من حيث حاصل السيقان والالياف في وحدة المساحة ·

INTRODUCTION

Manchurian Jute (*Abutilon avicinae*) is native to China. It is grown for its soft fibers. Its fiber is used in the same manner as Indian jute and kenaf for making twine and bagging. It was introduced to Egypt in 1936 (Al-Belqini, 1943), where two strains were selected and compared with kenaf (*Hibiscus cannabinus*) and Indian jute (*Corchorus capsularis* and C. *Olitorius*). Later it was introduced to Iraq in 1949 (Al-Sakkar, 1968).

More than a million of Iraqi Dinar worth of jutex fibers and bags is imported annually by the Iraqi Government (Al-Sakkar, 1968). Therefore, it is beneficial to find out the possibility of raising such crops locally to provide the industry with the required raw materials.

The main objective of the present work was to study the effect of spacing between hills within row and the number of plants per hill on total stem and fiber yields and fiber percentage.

Available literature on the subject is very limited. Kundu *et al.* (1959) found that close spacing between jute plants resulted in smaller diameter of stems and taller plants than wider spacing which in turn gave better yield of fibers.

MATERIALS AND METHODS

A split plot design was used with four replications. Seeds from an introduced variety of Manchurian jute from Egypt were planted in plots of five rows, 10 m long and 60 cm apart in a clay loam soil. Few seeds were planted in each hill. The distance between adjacent hills were 10, 20 and 30 cm randomly arranged and used as main plots. Plants per hill were thinned to 2, 3, 4 and 5 plants at random as sub-plots. The sub-plots were isolated from each other by one meter, while the distance to isolate main plots from each other was two meters. The duration of the experiment was three years (1959—1961) at the Abu-Ghraib Agricultural Experiment Station, Ministry of Agriculture. Dates of planting, emergence, thinning, flowering, harvesting and retting were recorded as in Table 1. It took 21 days to complete retting. Finally, the fibers were extracted, dried and weighed. Data of stem as well as fiber yields and percentage were analysed statistically.

TABLE 1. Dates of planting, emergence, thinning, flowering, harvesting and retting during three years (1959—1961).

	1959	1960	1961
Planting	8/3	23/3	15/4
Emergence	24/3	30/3	22/4
Thinning	—	9/5	30/5
Flowering	27/7	27/8	31/8
Harvesting	24/9	2/10	15/10
Retting	3/10	28/11	28/11

RESULTS AND DISCUSSION

Experiment 1959:

No, significant differences among treatments were detected (Table 2). However, it was noticed that the spacing of 30 cm between plants and four plants per hill gave the highest fiber yield of 416 Kg per donum*, followed by the 20 cm spacing and five plants per hill treatment that gave 397 Kg per donum (Table 3).

A highly positive correlation between stem diameter and plant height ($r = 0.828$), and a significant negative trend between plant height and fiber percentage ($r = -0.570$) were found. The positive correlation between yield and fiber percentage ($r = 0.376$) was almost significant. On the contrary, significant correlation between fiber yield and both stem diameter and plant height was obtained. The correlation coefficient between diameter and fiber percentage was negative but not significant, being —0.126. The negative correlation between fiber percentage, and both plant diameter and height obtained here are in general agreement with those obtained by Kundu *et al.* (1959).

Experiment 1960:

Almost similar results were obtaind in 1960 to those of 1959 with regard to yield of stems and fibers (Table 3). The treatment of 20cm spacing with four plants per hill gave the highest yield of fibers of 320 Kg per donum followed by the treatment of 20 cm spacing along with five plants per hill which gave 264 Kg per donum.

Experiment 1961:

In 1961, a significant difference was detected with regard to spacing; the 10 cm spacing between plants was superior in both stem and fiber yields (Table 4). The 10 cm spacing compined with five plants per hill gave 170 and 920 Kg for fiber and stem yields respectively, followed by the 10 cm

* 1 donum = ¼ hectare.

TABLE 2. Average stem height, stem diameter stem yield per donum, fiber yield per donum, and fiber percentage for the year 1959.

Spacing between plants cm	No. of plants per hill	Stem ht. m	Stem dia. cm	Stem yield Kg	Fiber yield Kg	Fiber percentage
10	2	2.89	0.90	1917	322	16.8
	3	2.76	0.88	2417	375	15.5
	4	2.58	0.81	1958	309	15.8
	5	2.66	0.82	2125	363	17.1
20	2	3.10	0.97	2042	372	18.2
	3	3.09	1.01	2083	285	13.7
	4	2.96	0.98	3042	386	12.7
	5	3.01	0.91	2208	397	18.0
30	2	3.12	1.00	2292	316	13.8
	3	3.09	0.98	2042	310	15.2
	4	2.95	1.00	2583	416	16.1
	5	2.93	0.95	2250	376	16.7
L.S.D. 5%				N.S.	N.S.	N.S.
1%				—	—	—

N.S. No significant difference.

TABLE 3. Average stem height, stem diameter, stem yield per donum, fiber yield per donum and fiber percentage for the year 1960.

Spacing between plants cm	No. of plants per hill	Stem ht. m	Stem dia. cm	Stem yield Kg	Fiber yield Kg	Fiber percentage
10	2	2.77	0.88	1239	220	17.8
	3	2.69	0.87	1314	252	19.2
	4	2.47	0.72	1374	235	17.1
	5	2.51	0.76	1467	242	16.5
20	2	2.76	0.85	1223	216	20.0
	3	2.78	0.90	1446	225	19.6
	4	2.88	0.89	1671	320	19.2
	5	2.61	0.82	1364	264	19.3
30	2	2.84	1.09	1157	211	18.2
	3	2.79	0.89	1301	234	16.2
	4	2.90	0.99	1498	244	17.5
	5	2.82	0.90	1419	235	17.5
L.S.D. 5%				N.S.	N.S.	N.S.
1%				—	—	—

N.S. No significant difference.

TABLE 4. Average stem height, stem diameter, stem yield per donum, fiber yield per donum and fiber percentage for the year 1961.

Spacing between plants cm	No. of plants per hill	Stem ht. m	Stem dia. cm	Stem yield Kg	Fiber yield Kg	Fiber percentage
10	2	2.11	0.80	888*	165*	18.6
	3	1.82	0.70	775*	142*	18.3
	4	2.02	0.72	944*	168*	17.8
	5	1.86	0.65	925*	170*	18.4
20	2	2.00	0.90	654	131	20.0
	3	2.00	0.65	710	126	17.8
	4	1.82	0.75	768	136	17.7
	5	2.09	0.78	787	142	18.0
30	2	1.94	0.85	556	93	16.7
	3	1.95	0.82	536	108	20.0
	4	1.86	0.80	605	111	18.4
	5	1.86	0.78	718	133	18.5
L.S.D. 5%				171	18	N.S.
1%				—	—	—

* $P < 0.05$

N.S. No significant difference.

spacing combined with four plants per hill with yields of 158 and 944 Kg per donum for fiber and stem yields respectively. These results coincide with those of Kundu (1958) and Kundu *et al.* (1959).

In general it is possible to conclude here , that close spacings of 10 cm along with four plants per hill is the best with regard to stem and fiber yields per unit area.

We are indebted for the field assistance of Mr. Abdul Yahab Abdulla.

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EFFECT OF DRILL SPACING ON YIELD AND YIELD COMPONENTS OF WHEAT (**Triticum aestivum L.**) VARIETIES

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(Received 17 February 1976)

SUMMARY

Three wheat (*Triticum aestivum* L.) varieties namely, Ajeba, Kenya-Gular and Maxipak were planted in 10 and 15 cm drill spacings in a split plot design. The grain yield and components of yield were analysed statistically.

The wheat varieties, Ajeba, Kenya-Gular and Maxipak differed significantly in grain yield and yield components, while drill spacings 10 and 15 cm did not differ significantly in these traits.

Only 1,000 seed weight of the three wheat varieties resulted from using 10 and 15 cm drill spacings differed significantly.

The grain yield and components of yield differed significantly each year.

Only the number of seeds per head and 1,000 seed weight of the three wheat varieties differed significantly according to variation in years.

The number of heads per 30 cm length resulted from 10 and 15 cm drill spacings responded differently in different years.

Since both 10 and 15 cm drill spacings did not lead to any significant differences in grain yield and yield components of the wheat varieties, it is recommended to use 15 cm drill spacing in planting these varieties, because it is easier and more economical.

الخلاصـــــة

زرعت ثلاثة اصناف من الحنطة هي عجيبة (محلية) وكيناكولار ومكسيباك بمسافة ١٠سم و ١٥سم بتطبيق تصميم الالواح المنشقة وحلل حاصل الحبوب ومكونات الحاصل احصائيا ٠

اختلفت اصناف الحنطة العجيبة وكيناكولار ومكسيباك معنويا في حاصل الحبوب ومكونات الحاصل ولم تختلف مسافتي الزراعة في سطور وهما ١٠سم و ١٥سم في هذه الصفات ٠

اختلف وزن ١٠٠٠ حبة لاصناف الحنطة عجيبة وكيناكولار ومكسيباك المزروعة على مسافة ١٠سم و١٥سم معنويا ٠

اختلف حاصل الحبوب ومكونات الحاصل معنويا ٠

اختلف عدد البذور للسنبلة ووزن ١٠٠٠ بذرة لاصناف الحنطة عجيبة وكيناكولار ومكسيباك معنويا حسب اختلاف السنين ٠

تفاعل عدد السنابل لمسافة ٣٠سم الناتج من استعمال مسافتي ١٠سم و ١٥ سم بصورة مختلفة في السنين المختلفة ٠

بما ان المسافتين ١٠ سم و ١٥سم لم تؤد الى فروقات معنوية في حاصل الحبوب ومكونات الحاصل لاصناف الحنطة عجيبة وكيناكولار ومكسيباك وعليه يوصي باستعمال مسافة ١٥سم بين السطور في زراعة هذه الاصناف لانها اسهل واكثر اقتصادا في التطبيق ٠

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the main winter grain crop in Iraq. The method of planting wheat practiced by Iraqi farmars is by broadcasting. The use of drill method in planting wheat is still considered new to most of the Iraqi farmers, although some farmers use the drill 15 cm apart in planting wheat under irrigation in the middle and southern irrigated regions.

El-Shamma (1967) indicated the best drill spacings in planting Ajeba 210

local wheat in the middle and southern irrigated regions was 15 cm in comparison to 20 and 30 cm. Since there is no data regarding the possibility of using narrower drill spacing, this study was suggested to find the suitable drill spacing and its influence on yield and yield components of Kenya-Gular, Maxipak and Ajeba 210 bread wheat varieties. Kenya-Gular and Maxipak were recently released for seed distribution in the middle and southern regions.

Wheat yield varied widely as a result of drill spacing. The 4, 5, 7, 8 and 9 inch drill spacings produced the highest yield of wheat, respectively (Baldwin, 1963; Furrer, 1964; El-Shamma, 1967; Mather, 1964 and Morita, 1966). But, Keisselbach *et al.* (1934), Salmon (1924) and Thatcher and Lewis (1937) reported a decline in wheat yield only when the drill spacing exceeded 11 inches. Kinra *et al.* (1963) found a reduction in yield, culm per square foot and plant height when the drill spacing was less than 7 inches. But kernel weight did not very by using 7, 9, 11 and 14 inch drill spacings. Ram and Smith (1962) obtained the highest number of tillers per plant by using 12 and 15 inch drill spacings.

Although the 4 and 3.5 inch drill spacings produced the highest yield of barley and oats, respectively (Baldwin, 1963), Middleton *et al.* (1964) found no variation in yield of barley by applying the 8 and 11 inch drill spacings.

MATERIALS AND METHODS

The experiment was conducted on a clay loam soil, using the spilt plot design with four replications in 1968—69, 1969—70 and 1970—71 at Abu-Ghraib Irrigated Station, College of Agriculture, University of Baghdad. The wheat varieties Kenya-Gular 1425, Maxipak and local Ajeba 210 were used as main plots. Each sub-plot treatment was planted in a plot (2 x 6 m) by using 12 rows 5m long and 15 cm apart and 18 rows 5m long and 10cm apart. The rate of seeding was 80Kg/ha and the date of sowing was during the first week of November yearly. The trial had been conducted in the same field in different years and each replicate or block occupied the same area in three

years. The plots were irrigated 3 times during the vegetative period and 2—3 times during heading and maturation periods. Weeding was done by hand implement 3 times at monthly intervals during the vegetative period. The grain yield was harvested from the central rows during the second week of May each year. The components of yield, namely, number of heads per 30 cm length, number of seeds per head and weight per 1,000 seed in grams, were numerated from a 30 cm distance from any central rows randomly as suggested by LeClerg *et al.* (1966). The grain yield and components of yield were analysed statistically as reported by LeClerg *et al.* (1966).

RESULTS AND DISCUSSION

The analysis of variance in Table 1 showed significant differences in the grain yield and yield components of the wheat varieties, Ajeba, Kenya-Gular and Maxipak and non significant differences in these traits by using 10 and 15 cm drill spacings. Kenya-Gular was the leading in grain yield and 1,000 seed weight, while Ajeba and Maxipak were the leading in number of heads per 30cm length and number of seeds per head, respectively. The grain yield, number

TABLE 3. Mean square values for the yield and components of yield of the various sources of variation.

Source of variation	D.F.	Yield Kg/ha	No. of heads per 30 cm length	No. of seeds per head	1,000 seed weight (g)
Year	2	28789207**	13847.50**	664.46**	115.97**
Variety	2	2508420*	576.00*	746.38**	211.73**
Year X variety	4	1360358	89.50	69.06*	81.11**
Error (a)	27	733279	116.26	11.48	8.28
Spacing	1	299409	45.00	40.96	12.64
Year X spacing	2	93604	649.00*	33.02	14.07
Variety X spacing	2	400083	20.50	13.44	35.96*
Year X variety X spacing	4	512215	13.00	2.63	12.12
Error (b)	27	576342	140.19	21.12	7.24

** $P < 0.01$
* $P < 0.05$

TABLE 1. Grain yield and yield components of three wheat varieties with 10 and 15 cm drill spacings (average 1969, 1970 and 1971).

Characters	Varieties			L.S.D.		Drill spacing		L.S.D.	
	Ajeba 210	Kenya-Gudar	Maxipak	5%	1%	10 cm	15 cm	5%	1%
Grain yield Kg/ha	1263	1903*	1505	292.52	395.50	1492	1621	N.S.	
No. of heads per 30 cm length	35.80*	31.25	26.00	11.06	14.94	31.81	30.22	N.S.	
No. of seeds per head	17.61	17.92	27.43**	3.47	4.69	21.74	20.23	N.S.	
1,000 seed weight(g)	31.89	37.28*	32.41	2.95	3.99	34.28	33.44	N.S.	

N.S. No significant difference.

* P < 0.05

** P < 0.01

TABLE 2. Seed yield and components of yield of three wheat varieties with 10 and 15 cm drill spacings (average 1969, 1970 and 1971).

Variety	Drill spacing 10 cm	Drill spacing 15 cm	L.S.D. 5%	L.S.D. 1%
	Seed yield Kg/ha			
Ajeba 210	1283	1243	N.S.	
Kenya-Gular	1690	2116		
Maxipak	1504	1505		
L.S.D. 5%	N.S.			
1%	N.S.			
	No. of heads per 30 cm length			
Ajeba 210	35.92	35.67	N.S.	
Kenya-Gular	31.67	30.83		
Maxipak	27.83	24.17		
L.S.D. 5%	N.S.			
1%	N.S.			
	No. of seeds per head			
Ajeba 210	18.17	17.05	N.S.	
Kenya-Gular	18.05	17.79		
Maxipak	29.00	25.85		
L.S.D. 5%	N.S.			
1%	N.S.			
	1,000 seed weight (g)			
Ajeba 210	31.69	32.09	N.S.	
Kenya-Gular	38.55**	36.00*		
Maxipak	32.60	32.22		
L.S.D. 5%	4.04			
1%	5.46			

N.S. No significant difference.

* $P < 0.05$

** $P < 0.01$

of heads per 30 cm length number of seeds per head of the varieties resulted from using 10 and 15 cm drill spacings did not differ significantly, while 1,000 seeds weight differed significantly (Table 2). Kenya-Gular produced the highest 1.000-seed weight in comparison to both Ajeba and Maxipak by using the 10 and 15 cm dril spacings, respectively.

Kenya-Gular was 50.67 and 26.45% higher in grain yield, 16.90 and 15.03% higher in 1,000 seed weight than both Ajeba and Maxipak. But Ajeba was 37.69 and 14.56% higher in number of heads per 30 cm length than both Maxipak and Kenya-Gular. While Maxipak was 55.76 and 53.67% higher in number of seeds per head than both Ajeba and Kenya-Gular.

Kenya-Gular produced 21.65, 16.25, 12.18 and 11.73% higher 1,000 seed weight than both Ajeba and Maxipak by using the 10 and 15 cm drill spacings.

Table 3 showed that the grain yield and components of yield differed significantly according to variation in years. Both the number of seeds per head and 1,000-seed weight of the wheat varieties responded differently in different years. Only the number of heads per 30 cm length resulted from using the 10 and 15 cm drill spacings differed significantly each. year.

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EFFECT OF IRRIGATION REGIME ON YIELD AND FIBER PROPERTIES OF UPLAND COTTON (Gossypium hirsutum L.) IN CENTRAL IRAQ[1]

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SUMMARY

A field irrigation experiment on cotton was conducted for two years; 1973 and 1974, at the Agricultural Experiment Station, University of Baghdad in Abu-Ghraib. A simple Latin square design was used with five irrigation treatments: dry, medium dry, medium wet and wet.

The highest seed cotton and lint cotton yield were obtained from the medium treatment, while the lowest seed cotton and lint yield were obtained from the dry treatment.

The longest fibers were obtained from the wet treatment, while the dry treatment produced the shortest fibers. The difference, however, was significant in the second year.

No significant difference in the uniformity ratio for fiber length was obtained among treatments.

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1. Part of thesis submitted by the senior author in partial fulfillment for the degree of Master of Science.

The difference in fiber strength was significant only in the second year. The highest and lowest fiber strength were obtained from the medium and dry treatments respectively.

The micronaire reading in the first year showed a significant superiority for the medium and medium wet treatment, over the medium dry treatment. The lowest micronaire reading was obtained from the medium treatment.

To obtain higher cotton yield along with good fiber properties cotton plants should be irrigated whenever the available soil moisture depleted to 60 percent.

الخلاصـــــة

اجرى بحث حقلي في عامى ١٩٧٣ و ١٩٧٤ في محطة التجارب الحقلية التابعة الى كلية الزراعة في ابي غريب لدراسة تأثير معاملات الرى المختلفة على حاصـــل القطن وصفات التيلة ٠

استخدم تصميم المربع اللاتيني لخمس معاملات رى وهي : جافة ، ومتوسطة الجفاف ، ومتوسطة ، ومتوسطة الرطوبة ، ورطبة وتم الحصول على النتائج التالية

١ ــ كان أعلى حاصل قطن زهر وشعر من المعاملة المتوسطة بينما اعطت المعاملة الجافة حاصل منخفض لقطن الزهر والشعر ٠

٢ ــ لم تكن الفروقات في طول التيلة عند (٥ر٢٪ من الطول المحدد بجهاز ديجيتال فايبروكراف) معنوية احصائيا في السنة الاولى بينما كانت هذه الفروق معنوية في السنة الثانية ٠ ومع ذلك ففي كلا السنتين فأن اطول الالياف تم الحصول عليها في المعاملة الرطبة ، بينما اعطت المعاملة الجافة أقصر الالياف ٠

٣ ــ لم يحصل فرق معنوي لانتظام الطول بين المعاملات ٠

٤ ــ وجدت فروق احصائية بالنسبة للمتانة في السنة الثانية فقط حيث اعطت المعاملة المتوسطة اعلى متانة بينما اعطت المعاملة الجافة أوطىء متانة ٠

٥ ـ بخصوص النعومة كانت قراءات جهاز الميكرونير احصائية بين المعاملات فقط في السنة الاولى حيث تفوقت المعاملتين المتوسطة والمتوسطة الرطبة بالنعومة على معاملة متوسطة الجفاف ٠

٦ ـ ممكن الحصول على أعلى حاصل قطن بسقي القطن كلما وصلت نسبة الرطوبة في التربة الى ٦٠٪ ٠

INTRODUCTION

Cotton is the second major summer crop in Iraq after rice, and it is grown mainly under irrigation system all over the country.

The variety "Coker 100 wilt" (*Gossypium hirsutum* L.) is the only variety grown at the present time. Mismanagement of irrigation during flowering and ball formation stages affect yield of cotton as well as fiber qualities (Christidis and Harrison, 1955). Lower yield and poor lint quality of cotton in Iraq is attributed to poor irrigation management, insect damage and other cultural practices.

Research on the water requirements of cotton is very limited in Iraq. The objectives of this study were to determine the effect of different soil moisture levels on cotton yield and fiber properties.

MATERIALS AND METHODS

This experiment was conducted at the Experiment Station, the College of Agriculture, University of Baghdad, in Abu-Ghraib during the years 1973 and 1974 on Hashimiyah silty loam soil (Al-Agidi, 1972). The field capacity and permanent wilting point of the soil were 27 and 10 percent (by weight) respectively. The average bulk density of the soil from 0-120 cm depth was 1.30 g/cm^3.

Land preparation started in February in the first year. Two deep plowings were made perpendicular to each other followed by disking and leveling. A preplanting irrigation was applied on 21 March to mark the planting line (level). Planting was completed one week later.

In the second year however land preparation, and planting were a month late due to late rainfall. Similar cultural practices were carried out.

The layout of the experiment was a simple Latin square design (5 x 5). Five irrigation treatments were replicated five times making 25 experimental units. Plot size was 7 x 4 m and each plot was separated by 1.5 m alleys. Each plot consisted of four furrows, 6 meters long and 90 cm apart. Five seeds were placed by hand in each hole 5 cm below irrigation line and 25 cm apart. The direction of furrows was from north to south and the planting was made in the eastern side of the furrows. The plots were fertilized with 60 Kg P_2O_5 per hectare of triple super phosphate (45% P_2O_5) added at planting time, together with 84 Kg nitrogen per hectare of ammonium sulfate (21%) was used. Half of it was added during planting and one quarter after thining and the rest at the beginning of flowering.

Emergence percentage was obtained by counting the number of seedlings after 11 days from planting in the two central furrows. Replanting took place two weeks after planting. The plants were thinned to two per hole after 42 days from planting. Hand weeding was performed four times during each season. Insects and especially the spiny boll worm (*Earias insulana*) and red spider (*Tetranychus atlanticus*) were controlled by spraying the plants with Anthio 40 and Azodrin both at a rate of 2237.76 cm^3 a.i. per hectare.

Percentage of seedling emergence, date of first flowering, first boll opening first and second pickings were recorded during the two years (Table 1).

TABLE 1. Date of planting, emergence percentage, and dates of first flower, first boll opening, first and second picking during the years 1973 and 1974.

Year	Date of planting	Mean emergence percentage	Date of first flower	Date of first boll opened	Date of first picking	Date of second picking
1973	28/3	88.56	2/6	11/7	17/8	16/11
1974	4/5	91.88	24/6	24/6	27/7	16/11

The irrigation treatments were applied 73 days after planting in both seasons. The source of water was the Euphrates river through the Abu-Ghraib canal. The irrigation treatments were as follows:—

1. Wet: when available soil moisture was depleted to 80 percent, the plots were replenished to 120 percent of original available soil moisture.

2. Medium wet: when available soil moisture was depleted to 80 percent, the plots were replenished to 100 percent of original available soil moisture.

3. Medium: when available soil moisture was depleted to 60 percent, the plots were replenished to 100 percent of original available soil moisture.

4. Medium dry: when available soil moisture was depleted to 24 percent, the plots were replenished to 100 percent of origional available soil moisture.

5. Dry: when available soil moisture was depleted to 20 percent, the plots were replenished to 100 percent of original available soil moisture.

The yield of the two pickings was taken from the two central furrows. Plants of the two holes at each end of the two central furrows were not included the yield of seed cotton and lint cotton were converted into Kg/ha. Fiber length was measured on 330 digital fibrograph. Uniformity ratio was calculated from the following equation:

$$U.R. = \frac{50\%\ SL}{2.5\%\ SL} \times 100$$

Fiber finess: measured on the wire fineness meter.

Fiber strength: measured on the Pressley fiber strength tester at "O" gage.

All data collected on yield and fiber properties were analyzed statistically according to Snedecor (1967).

RESULTS AND DISCUSSION

Yield: Average seed and lint cotton yield (Kg/ha) under five irrigation treatments for the first year are presented in Tables 2 and 3, and for the second year in Tables 4 and 5. Statistical analyses of the seed and lint cotton yields indicated that the differences among the irrigation treatments were significant at 0.01 level in both years. In the first year the highest seed cotton yield of 2109 Kg/ha was obtained from the medium treatment, while the dry treatment produced the lowest seed cotton yield (1180 Kg/ha); the increase in yield amounted to 79 percent.

The highest lint cotton of 694 Kg/ha was also produced by the medium treatment, while the dry treatment gave the lowest lint cotton yield (382 Kg/ha), the increase in lint yield amounted to 83 percent.

Similar results were obtained in the second year with a percentwise increase of 123 and 135 for the seed cotton and lint yields respectively.

TABLE 2. The average seed cotton yield in Kg/ha under the five irrigation treatments in 1973.

	Irrigation treatments				
Levels of probability	Dry	Medium dry	Wet	Medium wet	Medium
	1180	1584	1585	1828	2109
0.05					
0.01					

LSR	2	3	4	5
0.05	303	317	327	330
0.01	424	447	460	468

Note: Means which are underscored by the same line are not significantly different using Duncan's Range Test.

TABLE 3. The average lint cotton yield in Kg/ha under five irrigation treatments in 1973.

Levels of probability	Irrigation treatments				
	Dry	Medium dry	Wet	Medium wet	Medium
	382	514	520	662	699
0.05					
0.01					

LSR	2	3	4	5
0.05	104	109	111	113
0.01	145	152	156	158

TABLE 4. The average seed cotton yield in Kg/ha under five irrigation treatments in 1974.

Level of Probability	Irrigation treatments				
	Dry	Medium dry	Medium wet	Wet	Medium
	498	762	1007	1027	1110
0.05					
0.01					

LSR	2	3	4	5
0.05	271	285	293	296
0.01	381	401	412	419

Note: Those means which are underscored by the same line are not significantly different and those which are not underscored by the same line are significantly different using Duncan's Multiple Range Test.

TABLE 5. The average lint cotton yield in Kg/ha under five irrigation treatments in 1974.

Levels of probability	Irrigation treatments				
	Dry	Medium dry	Wet	Medium wet	Medium
	163	233	322	332	383
0.05					
0.01					

	LSR	2	3	4	5
0.05		73	76	78	79
0.01		102	107	110	112

TABLE 6. The average fiber strength, Pressley index of cotton under five irrigation treatments in 1974.

Level of Probability	Irrigation treatments				
	Dry	Medium dry	Medium wet	Medium	Wet
	7.85	8.11	8.16	8.27	8.28
0.05					

	LSR	2	3	4	5
		0.28	0.29	0.30	0.30

Note: Those means which are underscored by the same line are not significantly different and those which are not underscored by the same line are significantly different using Duncan's Multiple Range Test.

TABLE 7. The average fiber fineness of cotton (Micronaire value) under five irrigation treatments in 1973.

Level of Probability	Irrigation treatments				
	Medium dry	Wet	Medium wet	Dry	Medium
	4.17	4.29	4.31	4.35	4.40
0.05					
0.01					

LSR	2	3	4	5
0.05	0.14	0.15	0.15	0.16
0.01	0.19	0.20	0.21	0.21

TABLE 8. The average 2.5 percent span length under five irrigation treatments in 1974.

Level of Probability	Irrigation treatments				
	Dry	Medium dry	Medium wet	Medium	Wet
	2.43	2.50	2.51	2.52	2.55
0.05					
0.01					

LSR	2	3	4	5
0.05	0.053	0.056	0.058	0.058
0.01	0.075	0.079	0.081	0.082

Note: Those means which are underscored by the same line are not significantly different and those which are not underscored by the same line are significantly different using Duncan's Multiple Range Test.

Similar results were obtained by Stockton *et al.* (1961) who obtained the highest seed yield when over 50 percent of the available soil moisture remained in soil 0—90 cm deep.

Fiber length: Statistical analysis of the data of the first year revealed no significant difference in both 2.5 percent and 50 percent span length among irrigation treatments. However, in the second year, a significant difference existed at the 1 percent level in 2.5 percent span (Table 8). The longest span length (2.55 cm) was produced by the wet treatment, while the dry treatment produced the shortest span length (2.43 cm) and the medium treatment produced a span length of 2.52 cm.

The effect of irrigation regime on fiber length was studied by many investigators. Some workers found that the wet treatment produced longer fibers than the dry treatment and it was found that the critical period in cell development of fibers appears to be during the first 16 days after blossoming (Sturkie, 1934). On the other hand, Rijks (1965) and Jackson, (1968) found that medium and medium wet treatments produced the longest fibers.

Uniformity ratio: statistical analysis of the data revealed no significant difference in uniformity ratio among the irrigation treatments in the two seasons.

Fiber strength: significant difference among treatments were obtained at the 5% of probability only in the second year (Table 6). The highest Pressley index of 8.28 and the lowest value of 7.85 were obtained from the medium and dry treatments respectively.

Fineness: There was a significant difference at the 1% level in the first year only (Table 7). The medium dry treatment produced the lowest Micronaire reading of 4.17 while the medium treatment produced the highest

reading of 4.40. The wet treatment produced a Micronaire reading of 4.29 and did not differ significantly from the medium and the dry treatments. Spooner *et al* (1958) found that the lower Micronaire reading was obtained from the dry treatment. Jackson and Tilt (1968) and Rijks (1965) concluded that the highest Micronaire reading was obtained from the dry treatment.

Over all yield: To obtain the highest yield, cotton should be irrigated whenever the available soil moisture is depleted to 60 percent. Under this condition in the first year 25 irrigations were required and the total amount of water was 168.91 cm, while in the second year the number of irrigations was 26 and the total amount of water required was 172.60 cm.

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EFFECT OF SOWING DATES AND YEARS ON YIELD AND YIELD COMPONENTS OF FLAX (Linum unitatissimum L.)

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SUMMARY

Three seeding dates, the middle of each of October, November and December were used in planting three flax varieties, Moroccan 10, Moroccan 50 and Indian 68 for three years (1965—1967) in Abu-Ghraib at the irrigated College of Agriculture farm, University of Baghdad, on a Kahola silt clay loam soil. The design of the experiment was a split-plot with six replications. The characters studied were seed yield and components of yield (number of bolls/plant, number of seeds/boll and weight/1000 seeds).

Sowing dates affected seed yield and number of bolls/plant. The early sowing date resulted in a higher seed yield for the three flax varieties studied, and in a higher number of bolls/plant for only Moroccan 50 and Indian 68.

Flax varieties varied according to number of seeds/boll and weight/1000 seeds. Moroccan 50 produced higher number of seeds/boll than Moroccan 10 which produced heaviest seed weight.

Sowing dates and varieties responded similarly to seasonal variation in yield and yield components. Number of seeds/boll and seed weight were the only traits affected by seasonal variation.

الخلاصـــــة

استعملت ثلاثة مواعيد زراعة منتصف تشرين اول ، منتصف تشرين ثاني ومنتصف كانون اول في زراعة ثلاثة اصناف من الكتان هى مراكش ١٠ ، مراكش ٥٠ وهندى ٦٨ لمدة ثلاثة سنوات ٦٥ـ١٩٦٧ في محطة ابى غريب الاروائيـــة الحقلية بكلية الزراعة جامعة بغداد في تربة طينية غرينية ٠

كان تصميم التجربة من نوع الاحواض المنشقة بستة مكررات ٠ ان الصفات التى تمت دراستها هى حاصل البذور ومكونات الحاصل (عدد الثمار للنبات ، عدد البذور للثمرة ووزن ١٠٠٠ بذرة) ٠

اثر موعد الزراعة على حاصل البذور وعدد الثمار للنبات وادى موعد الزراعة المبكر الى حاصل اعلى لاصنا فالكتان الثلاثة المدروسة وعدد اعلى من الثمار للنبات بالنسبة للمراكش ٥٠ وهندى ٦٨ ٠

اختلفت اصناف الكتان حسب اختلاف عدد البذور للثمرة ووزن ١٠٠٠ بذرة انتج المراكش ٥٠ عدد اعلى من البذور للثمرة من مراكش ١٠ الذى انتج اثقل وزن للبذور ٠

تفاعلت مواعيد الزراعة والاصناف بصورة متشابهة حسب الاختلاف في الحاصل ومكوناته ٠ وعموما فان عدد البذور للثمرة ووزن البذور هى الصفتان الوحيدتان التى تأثرت بموسم الزراعة ٠

INTRODUCTION

Flax is the only winter oil crop being planted in Iraq. Date of sowing ranges from the first of October to the middle of December. The local flax variety used in the country is Moroccan 10. Evaluation of this variety along with two others, namely, Moroccan 50 and Indian 68 was attempted in this study. The last two varieties were selected in 1961 from a four year varietal yield trials for superiority in seed yield and oil content in comparison to Moroccan 10 (El-Shamma, 1966). These three which are dual purpose varieties are grown in Iraq as flax-seed varieties.

Spratt *et al.* (1963) reported variation among varieties in number of bolls per plant and weight per 1000 seeds. The highest yield from both early and late maturing varieties was obtained by early sowing date. McGregor (1964) working with one flaxseed variety showed that date of sowing had an effect on the number of bolls per plant and the number of seeds per boll produced.

The potential yield of a plant, although depending much on heredity, is modified to a large extent by the environment under which the plant is grown, next to cultural practices (irrigation and fertilization), and date of sowing. The role of the latter factor in determining the yield components of flax in Iraq is not yet known. The purpose of this study which is related to a previous work (El-Shamma and Al-Hasan, 1969), was to clarify this point.

MATERIALS AND METHODS

Three sowing dates, the middle of each of October (MO), November (MN) and December (MD) were used for planting three flax varieties, Moroccan 10, Moroccan 50 and Indian 68. A splitplot experiment with six replications was carried out in Abu-Ghraib at the irrigated farm, College of Agriculture, University of Baghdad, on a Kahola silt clay loam soil for three years 1965-1967. Each variety was planted in four rows 5 m long and 30 cm apart. Rate of seeding was 25 Kg/ha. The trials were conducted every year at the same field

with each replicate occupying the same area of the field. The experiment was hand-weeded three times and irrigated six times during the entire growing season of the crop.

Plant samples were taken at random from a 30 x 30cm area from one of the central rows to study yield components. Bolls were threshed by hand to calculate number of seeds per boll and weight of 1000 seeds. Seed yield was obtained by harvesting the central rows. Bolls were collected, threshed and cleaned. Seeds were weighed and the weights were converted into Kg/ha. Data were analyzed statistically according to the methods of analysis of variance.

RESULTS

Seed yield and number of bolls per plant were affected significantly by sowing dates (Tables 1 and 2), whereas, number of seeds/boll and weight/1000 seed were not affected (Tables 3 & 4).

Flax varieties responded similarly to sowing dates in seed yield and number of seeds/boll but reacted differently in number of bolls/plant and seed weight as indicated by the significant interaction of sowing date X varieties (Table 5).

The overall yield of flax varieties, regardless of sowing dates, did not differ significantly in seed yield or in number of bolls/plant (Tables 1 and 2) but did differ in number of seeds/boll and weight/1000 seed (Tables 3 & 4).

The combined analysis of data revealed that seasonal effects were not significant on either seed yield or number of bolls/plant. The effects, however, were highly significant on number of seeds/boll and seed weight (Table 5). The effect of sowing dates and varieties on seed yield or number of bolls/plant did not very significantly from year to year. But the effect on number of seeds/boll and seed weight varied significantly as indicated by the first order interaction of years X sowing dates and years X varieties. The second order interaction of years X sowing dates X varieties was not significant (Table 5).

TABLE 1. Average seed yield of flax as affected by sowing dates (Kg/ha).

Varieties	Date of planting			Mean
	Mid October	Mid November	Mid December	
Moroccan 10	2133*	1718	940	1597
Moroccan 50	2223**	1588	1012	1607
Indian 68	2158*	1819	1037	1671
LSD 0.05	333			N.S
0.01	489			
Means	2171**	1708	996	
LSD 0.05	236			
0.01	336			

* $P < 0.05$.

** $P < 0.01$.

N.S. not significant.

TABLE 2. Average number of bolls/plant of flax as affected by sowing dates.

Varieties	Date of planting			Mean
	Mid October	Mid November	Mid December	
Moroccan 10	27.4**	16.6	16.2	20.1
Moroccan 50	18.2	16.0	15.2	16.4
Indian 68	23.1	21.6	15.7	20.1
LSD 0.05	7.5			4.1
0.01	10.1			
Means	22.9	17.8	16.0	
LSD 0.05	N.S			

** $P < 0.01$.

N.S. not significant.

TABLE 3. Average number of seeds/boll of flax as affected by sowing dates.

Varieties	Date of planting			Mean
	Mid October	Mid November	Mid December	
Moroccan 10	5.2	5.2	5.4	5.3
Moroccan 50	6.3	6.4	7.0	6.5*
Indian 68	5.6	6.2	5.6	5.8
LSD 0.05	N.S			1.0
Means	5.7	5.9	6.0	
LSD 0.05	N.S			

* $P < 0.05$.

N.S. not significant.

TABLE 4. Average weight/1000 seeds of flax as affected by sowing dates (g).

Varieties	Date of planting			Mean
	Mid October	Mid November	Mid December	
Moroccan 10	9.6	9.3	10.0	9.6**
Moroccan 50	8.4	8.2	7.9	8.2
Indian	8.3	8.0	7.8	8.0
LSD 0.05	N.S			0.4
0.01				0.6
Means	8.7	8.5	8.6	
LSD 0.05	N.S.			

** $P < 0.01$.

N.S. not significant.

TABLE 5. Mean squares from the combined analyses of the yield and yield components of flax.

Source of Variation	seed yield	No. of bolls/plant	No. of seeds/boll	Weight/1000
Replications (R)	156623	123	2.7	0.31
Sowing dates (S)	3025507**	649**	1.3	1.03
Error *a*	24279	95	2.6	0.43
Varieties (V)	13958	240**	21.2**	44.51**
S X V	19044	203**	1.8	2.09*
Error *b*	25761	34	1.6	0.57
Years (Y)	834869	475	26.8**	13.60**
Y X S	79315	269	5.5*	1.54**
Y X V	73320	204	8.6**	2.46**
Y X S X V	25062	117	0.9	0.68
Error *c*	1670576	268	1.8	0.31

* $P < 0.05$.
** $P < 0.01$.

TABLE 6. Correlation coefficient values among traits of the three flax varieties tested in 1965—1967 (average 3 years).

Characters Correlated	r
Seed yield and number of bolls/plant	0.521**
Seed yield and number of seeds/boll	0.175
Seed yield and weight/1000 seed	0.106
Number of bolls/plant and number of seeds/boll	—0.135
Number of bolls/plant and weight/1000 seed	—0.101
Number of seeds/boll and weight/1000 seed	—0.156

** $P < 0.01$.

A significant positive correlation was found between seed yield and number of bolls/plant ($r = 0.52$). The correlation between seed yield and each of number of seeds/boll and weight/1000 seed was positive and not significant. Correlations among yield components were negative and lacking significance (Table 6).

DISCUSSION

Sowing dates affected seed yield and number of bolls/plant, but did not affect number of seeds/boll and seed weight. On the average, MO gave significantly higher seed yield than MN and MD. MO, however, gave significantly higher number of bolls/plant than MD (Tables 1 and 2). According to McGregor (1964) seeding dates affected seed yield, number of bolls/plant and number of seeds/boll.

There were some variations among flax varieties in number of seeds/boll and seed weight; seed yields were not significantly different. Spratt *et al.* (1963) reported variations among flax varieties in number of bolls/plant and of seeds/boll than Moroccan 10, while the latter had the heaviest seed weight. weight of 1000 seed. In the present study, Moroccan 50 gave higher number

The flax varieties planted at different sowing dates showed variation in seed yield and number of bolls/plant (Tables 1 and 2), but did not show variation in number of seeds/boll and seed weight (Tables 3 and 4). These varieties gave higher seed yield and number of seeds/boll when planted at the first sowing date (MO) except for Moroccan 50 which showed no response of yield components to planting dates. Thus, the middle of October was the optimum planting date for obtaining higher seed yield from each of the three flax varieties tested.

Number of seeds/boll and weight/1000 seed resulted from applying different sowing dates or varieties were more affected by seasonal variation than seed yield and number of bolls/plant.

The increase in seed yield was greatly associated with the increase in number of bolls/plant and slightly related with each of number of seeds/boll and weight/1000 seed. The increase in either yield component may lead to a decrease in the other one. However, the potential to raise seed yield of flax by increasing yield components is still promising.

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REACTION OF DIFFERENT SESAME VARIETIES AND SEEDING DATES TO CHARCOAL ROT

(Sclerotium bataticola Taub.)

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SUMMARY

Four sesame varieties, white, red, grey and black were selected by applying the pure line selection procedure and planted at three seeding dates, May 1, June 1 and July 1. The seed yield and the percentage with charcoal rot infection caused by *Sclerotium bataticola* Taub. was studied in 1968 and 1969 seasons.

The red sesame variety which produced the highest yield in both seasons and at each seeding date was much resistant to charcoal rot than the white, grey and black sesame varieties in both seasons.

The variations in seeding dates and seeding dates x varieties resulted in a rather limited variation in seed yield and infection.

The decrease in seed yield of the sesame varieties planted at any seeding date in the second season was due to high percentage of infection with the disease.

Planting any of the sesame varieties at any seeding date in the second season in the same soil caused a high increase with charcoal rot infection. Thus sesame should not be planted in the same field yearly.

الخلاصـــــة

انتخبت أربعة أصناف من السمسم الابيض ، الاحمر ، الرمادى ، والاسود بطريقة الخط النقي وزرعت في ثلاثة مواعيد زراعة في ١ مايس ، ١ حزيران ، ١ تموز · درس حاصل البـذور ونسبة الاصـــابة المئـوية بالتعفـن الفحمي الذى وجد شائعا في ترب مختلفة مخصصة *Sclerotium bataticola* Taub. لزراعة السمسم ·

طبقت التجربة لمدة سنتين في الموسم الصيفي ١٩٦٨ ، ١٩٦٩ في محطة أبي غريب الازوائية بكلية الزراعة بأبي غريب ـ جامعة بغداد · تم عمل الالواح في نفس الحقل في كلا السنتين بحيث ان كل مكرر احتل نفس الموقع فيهما · تم ري النباتات اسبوعيا خلال الصيف وفترة اسبوعين خلال الربيع والخريف · حصدت النباتات المصابة بالمرض وغير المصابة من المروز الوسطية وفصلت بصورة منفردة لاحتساب النسبة المئوية للمرض · تم الحصول على حاصل البذور من النباتات المصابة وغير المصابة بالمرض من المروز الوسطية وحولت الى وحدة كغم/هكتار · حللت نسبة الاصابة المئوية بالمرض وحاصل البذور كغم/هكتار احصائيا ·

INTRODUCTION

Sesame is the only summer oil crop planted by farmers in Iraq. The variety used is a mixture of white, red, grey and black sesame. The major factor which limits the production of sesame in Iraq is the infection with charcoal rot caused by *Sclerotium bataticola* Taub.

It was possible to obtain pure varieties of the white, red, grey and black local sesame by means of individual plant selection from 1957 to 1965. These varieties were used for studying the percentage of infection by charcoal rot in 1968 and 1969.

This investigation was based on natural infection of the disease in order to obtain an applied result on the nature of the disease and the rection of the varieties under the field conditions.

The charcoal rot disease is spread in all the regions of Iraq as reported by the Directorate General of Plant Protection Reports 1961* and 1973 by Al-Beldawi and Burhan (1973).

MATERIALS AND METHODS

Three seeding dates May 1, June 1 and July 1 in 1968 and 1969 were used in planting four varieties of sesame, namely, white, red, grey and black in a split plot experiment with four replications Seeding dates were used as main plots and varieties as sub plots. Varieties were selected randomly in each seeding date which was also selected randomly. Each variety was drilled by hand in four furrows 90 cm apart, 5 m long at a seeding rate of 8 Kg /ha. The soil used was planted over 10 years with sesame only and was heavily infected with charcoal rot *Sclerotium bataticola* Taub., which was found prevalent in the different Iraqi soils located to sesame plantation.

The duration of the experiment was two years (1968 and 1969) at the Abu-Ghraib Irrigated Station, College of Agriculture, University of Baghdad. The plots had been conducted in the same field in different years with each replicate or block occupied the same area in two years. The plots were irrigated weekly during the summer and fortnightly in the spring and fall.

The individual plants which dried off due to infection with charcoal rot and the non-infected plants were harvested from the central furrows and separated for cacIculating the percentage of infected plants with charcoal rot. The seed yield was obtained from the infected and non-infected plants in the central furrows and converted to Kg/ha. The percentage of infection with charcoal rot and seed yield Kg/ha were analysed statistically.

The information related to weather data in Table 3 were used for comparison of the seed yield and disease infection obtained in Tables 1 and 2 in 1968 and 1969.

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* Unpublished.

RESULTS AND DISCUSSION

The evaluation of sesame production under the Iraqi conditions could be achieved by the investigation on its susceptability to charocoal rot caused by *Sclerotium bataticola* Taub., which is the major factor limiting the yield of sesame varieties In this study the results of two seasons of experimentations will be discussed under three main topics namely, seed yield Kg/ha., percentage of charcoal rot infection. and correlation between yield and wilt infection.

Seed yield Kg/ha:

The mean yield of the sesame varieties planted at 3 different seeding dates in 1968 and 1969 is presented in Tables 1 and 2. The difference in the yield of sesame among varieties was significant in 1968 only. The red sesame variety produced the highest yield and the black variety the lowest at each seeding date in both seasons. The yield in the first reason was much higher than the second season. Most of the sesame varieties produced higher yield in each seeding date in the first season than the second, although the variation in weather conditions, especially temperature during growth, flowering and maturity was very close in both seasons (Table 3), and the amount of water used in irrigation was fairly controlled. The main reason for the decrease in yield in the second season was due to heavy infection with charcoal rot in this season. It should be mentioned that the variation in yield resulted from seeding dates and seeding dates x varieties was not significant, although the second date resulted in higher yield in the first and second seasons in comparison to the first and third seeding dates, respectively.

Percentage of charcoal rot infection:

The variation in charcoal rot infection among the different varieties. seeding dates and seeding dates x varieties was not significant (Tables 1 and 2). However, in both seasons the red sesame was less infected with the rot at

TABLE 1. Seed yield Kg/ha and percentage of charcoal rot infection of 3 sesame varieties planted at 3 seeding dates in 1968.

Seed Yield Kg/ha				
Varieties	1st date	2nd date	3rd date	Mean
White	394.04	420.70	211.09	141.94
Red	625.13	763.63	234.79	541.18
Gray	327.38	276.27	199.98	267.87
Black	191.09	189.61	122.21	167.64
Mean	384.41	412.55	192.02	
LSD for Varieties at 5% = 187.24, 1% = 256.49				

% Charcoal Rot Infection				
Varieties	1st date	2nd date	3rd date	Mean
White	42.00	27.66	20.00	29.89
Red	16.00	23.33	11.66	17.00
Gray	25.00	25.66	15.33	22.00
Black	49.33	43.33	25.66	39.44
Mean	33.08	30.00	18.19	
No significant difference.				

TABLE 2. Seed yield Kg/ha and percentage of sharcoal rot infection of 3 sesame varieties planted at 3 seeding dates in 1969.

Seed Yield Kg/ha				
Varieties	1st date	2nd date	3rd date	Mean
White	218.08	311.41	242.84	257.44
Red	264.75	364.74	333.51	321.00
Gray	151.04	280.90	131.42	187.79
Black	140.00	260.94	104.76	168.57
Mean	193.47	304.51	203.12	
No significant difference				

% Charcoal Rot Infection				
Varieties	1st date	2nd date	3rd date	Mean
White	56.76	42.33	33.68	47.26
Red	18.32	28.92	27.33	24.86
Gray	55.18	43.49	58.46	52.38
Black	49.88	54.20	53.83	52.64
Mean	47.29	42.24	43.33	
No significant difference.				

TABLE 3. Mean maximum and minimum temperature, rainfall, relative humidity % and wind speed in 1968 and 1969 from planting to maturity of the different sesame seeding dates.

	Temperature °C				Rainfall		Relative Humidity				Wind Speed	
	1968		1969		1968	1969	1968		1969		1968	1969
Month	Max.	Min.	Max.	Min.	mm	mm	1200 GMT	0300 GMT	1200 GMT	0300 GMT	Knots	
May	35.3	20.8	36.6	21.1	15.1	0.2	23	60	20	52	6	7
June	38.8	22.7	41.5	24.1	tr.	0.0	16	34	11	37	7	8
July	43.4	26.0	42.0	25.3	0.0	0.0	13	32	12	36	8	9
August	40.4	23.2	42.3	24.4	0.0	0.0	16	41	13	38	11	6
September	39.3	21.8	39.6	21.5	0.0	0.0	17	43	16	47	01	7
October	34.2	17.5	33.3	19.1	1.1	15.7	24	54	25	53	7	9

any seeding date used than any other sesame variety. The percentage of infection of each variety planted in the first season was lower than that in the second. Since charcoal rot is a soil borne disease, the increase in the infection of this disease in the second season in comparison to the first season may be attributed mainly to the replanting of the experiment in the same soil in the second season. A suggested three or four course rotation may reduce the accumulation of the fungi.

Correlation coefficient between yield and charcoal rot infection:

The correlation coefficient between seed yield and charcoal rot infection (% of wilt infection) was negative and significant in both seasons,being —0.359 ($P < 0.05$) for 1968 and —0.324 ($P < 0.05$) for 1969. The increase in charcoal rot infection led to a decrease in yield of each sesame variety planted at any seeding date in both seasons. Thus the production of a disease resistant variety will cause increase in the yield of this variety, if the variety is adapted to the Iraqi conditions.

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PHYLOGENETIC RELATIONSHIPS IN THE GENUS **TRIFOLIUM** L.

II. CHROMATOGRAPHIC AFFINITIES

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SUMMARY

According to chromatographic studies on the free amino acids, the eleven species of *Trifolium* were divided into 4 groups: I: *T. alexandrinum, T. pratense, T. lappaceum, T. hirtum,* and *T. nigrescens.* Group II:*T. alexandrinum, T. lappaceum, T. resupinatum,* and *T. subterraneum.* Group III: *T. pratense, T. medium. T. repens, T. hybridum,* and *T. nigrescens.* Group IV: *T. fragiferum* only. Studies on canavanine showed that it was present in all 20 cultivars of *Trifolium* species with varying degrees of colour intensity. Thus, it was concluded that quantitative rather than qualitative differences in canavanine were present. The significance of these chromatographic findings in phylogenetic studies of the genus *Trifolium* was discussed.

الخلاصـــــة

امكن تقسيم ١١ نوعا من جنس ترايفوليوم *Trifolium* ممثلة بعشرين صنفا الى اربعة مجاميع طبقا للدراسات الكروماتوجرافية على الاحماض الامينية الحرة كالاتى :

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المجموعة الاولى وتشمل الانواع :

T. pratense, T. alexandrinum, T. nigrescens, T. hirtum, T. lappaceum.

المجموعة الثانية وتشمل الانواع :

T. lappaceum, T. alexandrinum, T. subterraneum, T. resupinatum.

المجموعة الثالثة وتشمل الانواع :

T. medium, T. pratense, T. nigrescens, T. hybridum, T. repens.

المجموعة الرابعة وتشمل النوع *T. fragiferum* فقط ٠

وقد تبين من الدراسة على الحامض الاميني الحر كانافانين Canavanine انه موجود في كل الاصناف العشرين ولكن بدرجات متفاوتة من كثافة اللون ٠ مما يوحي بوجود اختلافات كمية بين الانواع في احتوائها على هذا الحامض ٠ وقد نوقشت اهمية هذه النتائج الكروماتوجرافية بالنسبة للعلاقات التطورية في جنس ترايفوليوم ٠

INTRODUCTION

Chemotaxonomic techniques have been used extensively to elucidate possible phylogenetic relationships in many plant genera. Among these techniques, chromatography has been considered one of the best tools in this respect. However, as the "protein-bound" amino acids are commonly present in all living species, the differences in their concentration may not necessarily be of genetic origin. On the other hand, the presence of free amino acids in general and an "uncommon" free amino acid in particular may single out a species which contains it as being peculiarly different in the genetic sense from a species which does not. Such amino acids could be of primary importance in the evolutionary studies as readily identifiable phylogenetic markers.

The objects of this study were to determine the biochemical affinities between the genotypes of the 20 cultivars of *Trifolium* as indicated by their chromatographic patterns for free amino acids, to detect the presence of the

uncommon amino acid canavanine in these cultivars, and to assess the significance of chromatographic technique in predicting successful interspecific hybridization.

Taylor and Collins (1964) found that chromatographic patterns of *T. pratense* and *T. diffusum* were indentical. Collins and Taylor (1964) reported that the same species when hybridized, their amphidiploid had similar patterns of chromatography.

Parups *et al.* (1966) divided *Trifolium species* into groups according to their chemotaxonomic relationships. Taylor and Keller (1968) observed a close relationship between *T. pratense* and *T. subterraneum, T. lappaceum, T. diffusum, T. pallidum, T. cherleri* and *T. hirtum.* The found distant relationships between *T. campestre, T. pratense* and *T. dubium.* Abdel-Tawab (1970) indicated a close relationship between *T. medium* and *T. pratense* based on their chromatographic patterns. Taylor and Anderson (1972) divided 37 species of *Trifolium* into three major groups according to their polyphenolic compounds.

Of the "uncommon" amino acids found in various species of the *lotoideae,* canavanine is the most characteristic: ($H_2N.C(:NH).NH.O.CH_2CH(NH_2).CO_2H$). It is one of the nitrogen-rich amino acids of the *leguminosae,* and has been found to accumulate in high concentrations in the seeds of several species and disappear during germination. Bell (1958) showed that canavanine was present in the seeds of sixteen leguminous plants. He gave qualitative values for eight, and isolated the acid from two of them. Bell (1960) detected canavanine in the seeds of 11 species of leguminous plants. Birdsong *et al.* (1960) studied 219 species in the family *leguminosae* representing 109 genera with respect to the occurrence of canavanine. They found that some species produced canavanine while others did not. They interpreted these results as being of phylogenetic significance. Turner and Harborne (1967) recorded that canavanine has been found in 35% of the 150 genera of *lotoideae* which make up the-family

and in 60% of the 540 species examined. All species of *Medicago* and *Trifolium* analysed were found to contain canavanine.

MATERIALS AND METHODS

Twenty cultivars representing 11 species of *Trifolium* L. were used in this study. The scientific names of cultivars, F.C. number, origin, and chromosome numbers for these cultivars are shown in Table 1.

Paper chromatography: 2.0 g of each *Trifolium* grain powder were homogenized and extracted according to the method of El-Eryani and Fleming (1968). Whatman No. 1 paper was used in one dimensional accending technique, two runs in the cabinet were made for each paper, first with (60 : 15 : 25) followed by (4 : 1 : 1) of N-butanol-acetic acid-water (v/v/v). Each run took about 48 hrs and the air dried paper was sprayed with 0.25% ninhydrin in acetone and were oven dried for 3 minutes at 100°C. Amino acids were identified by their Rf values, colour of spots, and by co-chromatography with known samples of a mixture of pure amino acids.

Canavanine identification: To prepare the seed extracts, 0.2 g of ground seed was stirred with 2 ml of 0.1 N HCl at room temperature and kept for 1 h according to Bell (1958); 0.2 ml of the extract was applied to Whatman No. 1 paper and chromatographed in phenol-water (4 : 1, w/v) followed by butanol-pyridine-acetic acid water (4 : 1 : 1 : 2), (v/v/v/v), (Makisumi, 1952). Each chromatogram was developed for 24 h, then air dried paper was sprayed with phosphate buffer (0.066 M-NaH_2PO_4 and 0.066 M-Na_2HPO_4 . v/v), then with Pentacyanoammonioferrate (1%) according to Fearon (1946).

RESULTS AND DISCUSSION

Free amino acids for each of the 20 cultivars were identified on the chromatograms, Figures 1 and 2 Each cultivar was given a (+) sign whenever an amino acid spot was present and (—) sign when absent. The results

TABLE 1. The code number, scientific name, common name, cultivars, F.C. number, orgin, and chromosome number (2n) of eleven *Trifolium* species.

Code No.	Scientific name	Common name	Cultivar	F.C.	Origin	Chromosome No. (2n)
1	*T. alexandrinum*	Egyptian clover	Miskawi	—	Ministry of Agriculture (Egypt)	16
2	*T. alexandrinum*	Egyptian clover	Khadrawi	—	,,	16
3	*T. alexandrinum*	Egyptian clover	Seidi	—	,,	16
4	*T. alexandrinum*	Egyptian clover	Fahl	—	,,	16
5	*T. alexandrinum*	Egyptian clover	Hustler	38.562	California	16
6	*T. alexandrinum*	Egyptian clover	Wafir	—	Bahteem	16
101	*T. pratense*	Red clover	Chesapeake	39.378	Certified, Washington	14
103	*T. pratense*	Red clover	Kentucky, Syn, A-2	38.376	Syn, Kentucky AES	14
105	*T. pratense*	Red clover	Tensas	39.382	Foundation, Louisiana	14
91	*T. medium*	Zigzag clover	—	39.743	Colorado AES	84
151	*T. lappaceum*	Lappa clover	—	39.079	Mississippi AES	16
171	*T. hirtum*	Rose clover	Common	38.528	California	10
82	*T. subterraneum*	Sub clover	Baschus Marsh	38.577	Certified	16
165	*T. fragiferum*	Strawberry clover	Salina	37.839	Certified, California	16
202	*T. resupinatum*	Persion clover	Abon	39.429	Foundation, Texas	16
121	*T. repens*	White clover	Nolin's improved	39.384	Breeder, Louisiana	32
122	*T. repens*	White clover	Louisiana S-1	39.413	Foundation, Louisiana	32
124	*T. repens*	White clover	Ladino	39.415	Certified, California	32
188	*T. hybridum*	Alsike clover	—	37.765	U.S.A.	16
181	*T.nigrescens*	Ball clover	Common	39.380	Common, Alabama	16

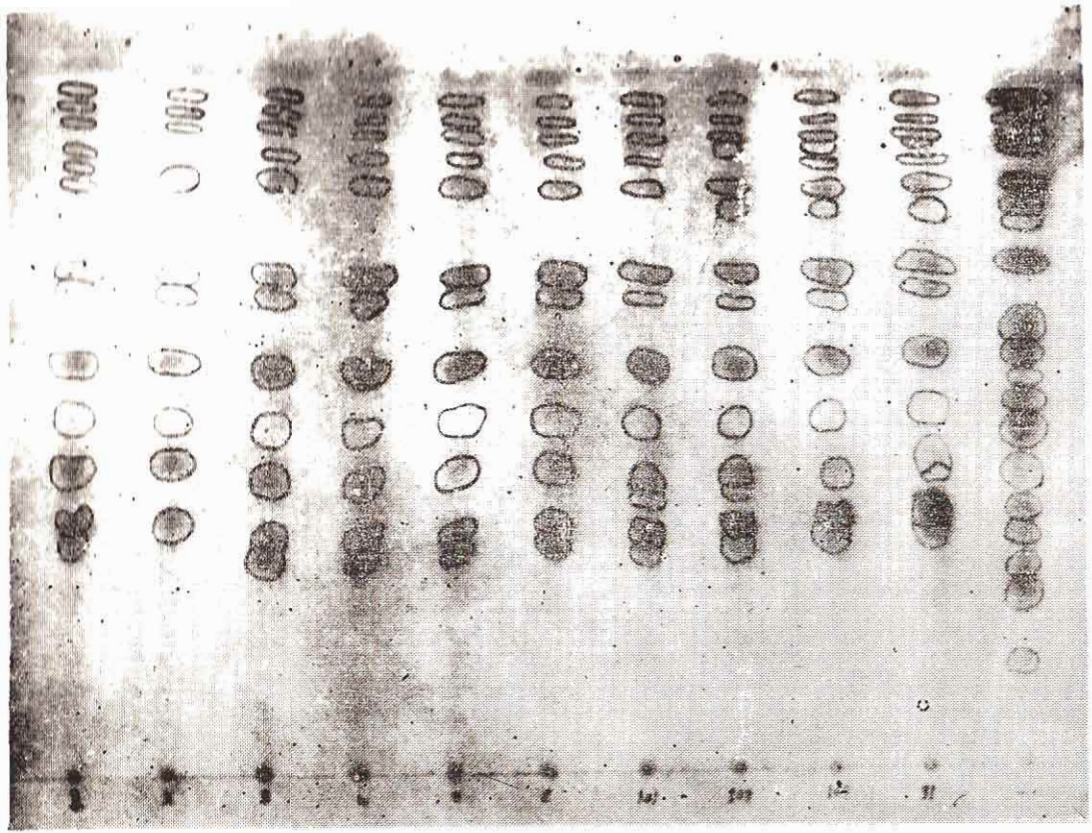

Fig. (1): Chromatographic patterns of *T. alexandrinum* (1 through 6) *T. pratense* (101, 103, 105) and *T. medium* (91).

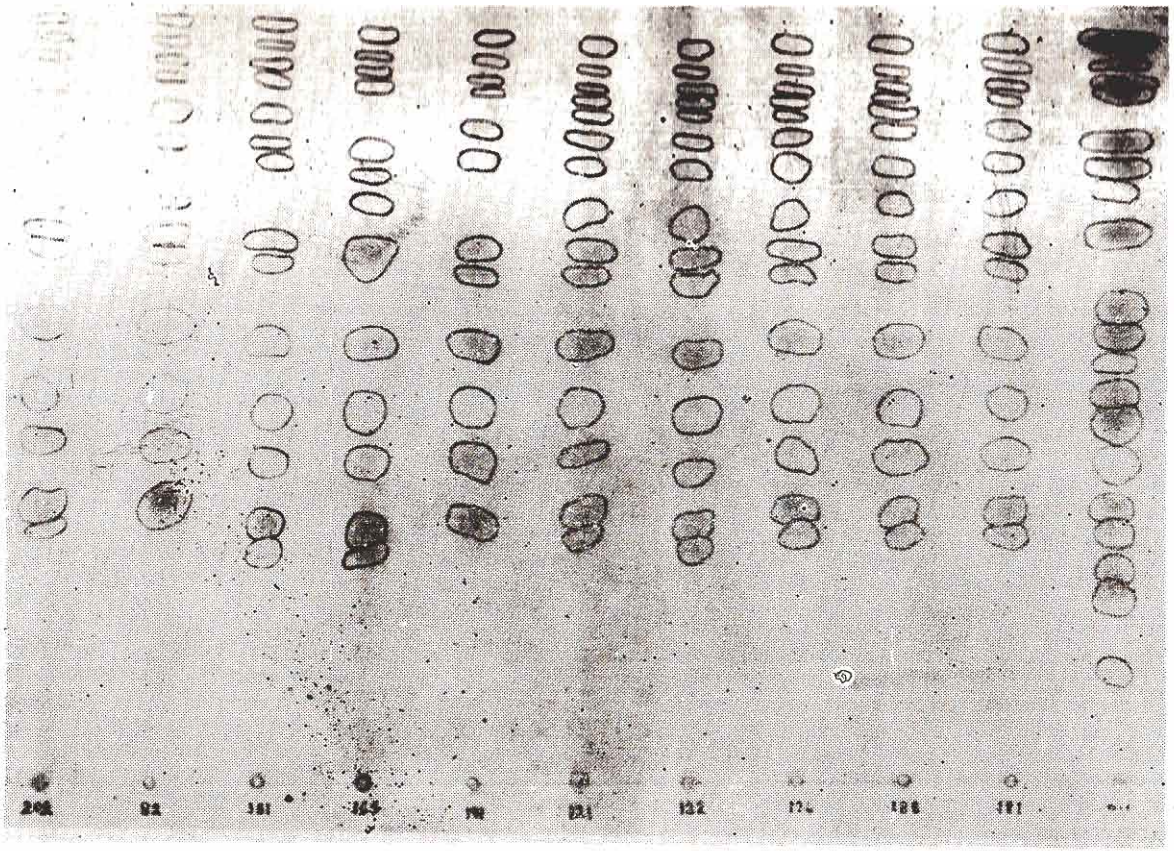

Fig. (2): Chromatographic patterns of *T. resupinatum* (202), *T. subterraneum* (82), *T. lappaceum* (151), *T. fragiferum* (165), *T. hirtum* (171), *T. repens* (121, 122, 124), *T. hybridum* (188) and *T. nigrescens* (181).

TABLE 2. Numerical analysis of chromatographic pattern of 20 cultivars of *Trifolium* for free amino acids.

Species	Amino acid spots																								
	Cyste.*	Cystl.	Orn.	Lys.	His.	Arg.	Asp.	Ser.	Gly.	Dihy. phen*	Hyd. prol.	Glu.	Thre.	Ala.	Tyr.*	Prol.	But.	Met.	Val.	Phen.*	Tryp.*	nor. Leu.	Leu.	Iso. Leu.
T. alex. (Miskawi)	—	—	—	—	+	+	—	+	+	—	—	+	+	+	—	—	+	+	+	—	—	+	+	+
T. alex. (Khadrawi)	—	—	—	—	—	+	—	+	+	—	—	+	+	+	—	—	—	+	—	—	—	+	+	+
T. alex. (Seidi)	—	—	—	—	+	+	—	+	+	—	—	+	+	+	—	—	—	+	+	—	—	+	+	+
T. alex. (Fahl)	—	—	—	—	+	+	—	+	+	—	—	+	+	+	—	—	—	+	+	—	—	+	+	+
T. alex. (Hustler)	—	—	—	—	+	+	—	+	+	—	—	+	+	+	—	—	—	+	+	—	—	+	+	+
T. alex. (Wafir)	—	—	—	—	+	+	—	+	+	—	—	+	+	+	—	—	—	+	+	—	—	+	+	+
T. prat. (Chesap.)	—	—	—	—	+	+	+	+	+	—	—	+	+	+	—	—	—	+	+	—	—	+	+	+
T. prat. (Kentucky)	—	—	—	—	+	+	+	+	+	—	—	+	+	+	—	+	—	+	—	—	+	+	+	+
T. prat. (Tensas)	—	—	—	—	+	+	—	+	+	—	—	+	+	+	—	+	—	+	+	—	+	+	+	+
T. medium	—	—	—	—	+	+	+	+	+	—	—	+	+	+	—	+	—	+	+	—	+	+	+	+
T. resupinatum	—	—	—	—	+	+	—	+	+	—	—	+	+	+	+	—	+	+	+	—	—	+	+	+
T. subterraneum	—	—	—	—	—	+	—	+	+	—	—	+	+	+	+	—	+	+	+	—	+	+	+	+
T. lappaceum	—	—	—	—	+	+	—	+	+	—	—	+	+	+	—	—	+	+	+	—	+	+	+	+
T. fragiferum	—	—	—	—	+	+	—	+	+	—	—	+	+	—	—	+	+	+	—	—	+	+	+	+
T. hirtum	—	—	—	—	—	+	—	+	+	—	—	+	+	+	—	—	—	+	+	—	+	+	+	+
T. rep. (Nolin)	—	—	—	—	+	+	—	+	+	—	—	+	+	+	—	+	—	+	+	+	+	+	+	+
T. rep. (La S—1)	—	—	—	—	+	+	—	+	+	—	—	+	+	+	—	+	—	+	+	+	+	+	+	+
T. rep. (Ladino)	—	—	—	—	+	+	—	+	+	—	—	+	+	+	—	+	—	+	+	+	+	+	+	+
T. hybridum	—	—	—	—	+	+	—	+	+	—	—	+	+	+	—	+	—	+	+	+	+	+	+	+
T. nigrescens	—	—	—	—	+	+	—	+	+	—	—	+	+	+	—	+	—	+	+	—	+	+	+	+

* Did not appear in the amino acid mixture. (+) = a.a. present. (—) = a.a. absent.

(Table 2), indicate the full range of free amino acids with regard to their presence or absence in the 20 cultivars. It is interesting to note that intraspecific as well as interspecific differences exist between the 20 cultivars in this respect. In order to determine the chromatographic similarities between the different cultivars on numerical basis, the coefficients of similarity for chromatographic patterns (Table 3) were calculated according to Sokal and Sneath (1963), for all species tested. In order to determine the degree of biochemical (chromatographic) affinities between the cultivars of this study, a minimum of 90% coefficient of similarity was taken as a criterion for a close relationship between pairs of cultivars. With regard to the six cultivars of *T. alexandrinum*, it was found that they were quite similar chromatographically. This is in agreement with Hussein (1971) who observed great deal of similarities between some cultivars of *T. alexandrinum*. Each of the six cultivars of *T. alexandrinum* was highly similar to each of the two cultivars of *T. pratense* (Chesapeake and Tensas) while Kentucky was dissimilar in this regard. *T. resupinatum* and *T. lappaceum* were closely related to the cultivars of *T. alexandrinum*. *T. hirtum* was quite similar to the cultivars of *T. alexandrinum* except Miskawi. *T. nigrescens* gave also the same results except with Miskawi and Khadrawi.

Two cultivars of *T. pratense* (Kentucky & Tensas) were highly similar while the third (Chesapeake) deviated from them. The three cultivars of *T. pratense* showed high affinity with *T. medium*, this is in agreement with Abdel-Tawab (1970). Cultivar (Tensas) of *T. pratense* showed similarity with *T. lappaceum*, *T. hirtum* and the three cultivars of *T. repens*. The two cultivars (Chesapeake and Kentucky) of *T. pratense* were distantly related to the other of *T. repens*. Cultivar Tensas showed close similarity with *T. hybridum*, while both Tensas and Kentucky gave high similarities with *T. nigrescens*. *T. medium* showed close affinities to each of the three cultivars of *T. repens*, *T. hybridum* and *T. nigrescens*, respectively. *T. resupinatum* was highly similar chromotographically to that of *T. subterraneum* and *T. lappaceum*. *T. subterraneum*

TABLE 3. Coefficient of similarity* for chromatographic patterns with regard to the presence or absence of free amino acids.

Variety	*T. alexandrinum*						*T. pratense*				*T. resup.*	*T. sub.*	*T. lapp.*	*T. frag.*	*T. hirt.*	*T. repens*			*T. hybr.*	*T. nig.*
	Misk.	Kadr.	Seidi	Fahl	Hust.	Wafir	Ches.	Kent.	Ten.	*T. med.*						Nolin	La S—1	Ladino		
T. Alex.																				
Miskawi	87	95	95	95	95	91	79	87	83	95	87	95	87	87	83	83	83	83	87	
Khadrawi		91	91	91	91	87	87	83	79	83	83	83	79	91	79	79	79	79	83	
Seidi			100	100	100	95	83	91	87	91	83	91	79	91	87	87	87	87	91	
Fahl				100	100	95	83	91	87	91	83	91	79	91	87	87	87	87	91	
Hustler					100	95	83	91	87	91	83	91	79	91	87	87	87	87	91	
Wafir						95	83	91	87	91	83	91	79	91	87	87	87	87	91	
T. Prat																				
Chesapeake							87	87	91	87	79	87	75	87	83	83	83	83	87	
Kentucky								91	95	75	75	83	87	83	87	87	87	87	91	
Tensas									95	83	83	91	87	91	95	95	95	95	100	
T. med.										79	79	87	83	87	91	91	91	91	95	
T. resup.											91	91	79	83	79	79	79	79	83	
T. sub.												91	79	91	79	79	79	79	83	
T. lapp.													87	91	87	87	87	87	91	
T. frag.														79	83	83	83	83	87	
T. hirt.															87	87	87	87	91	
T. rep.																				
(Nolin)																100	100	100	95	
(La's—1)																	100	100	95	
(Ladino)																		100	95	
T. hybr.																			95	

* Coefficient of similarity C.S. $= \frac{m}{N} \times 100$ where: N = Total number of spots (matched + unmatched).
m = matched pairs (either both are plus or both are minus).

showed hight affinities to each of *T. lappaceum* and *T. hirtum*, also *T. lappaceum* was highly similar to *T. hirtum* and *T. nigrescens*. At the same time identical chromatograms were observed between the three cultivars of *T. repens* as well as between each of these three cultivars and *T. hybridum* and *T. nigrescens*.

The 11 species could be separated into the following chromatographic groups:

Croup I : *T. alexandrinum, T. pratense, T. lappaceum, T. hirtum and T. nigrescens.*

Group II : *T. alexandrinum, T. lappaceum, T. resupinatum* and to some extent *T. subterraneum.*

Group III : *T. pratense, T. medium, T. repens, T. hybridum* and *T. nigrescens.*

Group IV : *T. fragiferum* only.

Success in interspecific hybridtzation is more likely within a group rather than between groups. These results are in agreement with Collins and Taylor (1964) in putting *T. repens* and *T. nigrescens* in the same group and disagreed with them in placing *T. fragiferum* with *T. hybridum* and *T. medium* in one group and *T. pratense* with *T. subterraneum* in another group. This is also in agreement with Taylor and Keller (1968) who observed a close relationship between *T. pratense, T. lappaceum,* and *T. hirtum,* and it disagreed in putting *T. pratense* and *T. subterraneum* in one group.

Canavanine studies: The spots of canavanine on chromatographic paper gave magenta colour of varying intensity. These spots were graded according to the degree of intensity of their colours, and each of the 20 cultivars was given a numerical rank as presented in Table 4. It was found that the amino acid canavanine was present in all 20 cultivars with varying degrees of colour intensity which might indicate that quantitative rather than qualitative

showed hight affinities to each of *T. lappaceum* and *T. hirtum*, also *T. lappaceum* was highly similar to *T. hirtum* and *T. nigrescens*. At the same time identical chromatograms were observed between the three cultivars of *T. repens* as well as between each of these three cultivars and *T. hybridum* and *T. nigrescens*.

The 11 species could be separated into the following chromatographic groups:

Croup I : *T. alexandrinum, T. pratense, T. lappaceum, T. hirtum and T. nigrescens.*

Group II : *T. alexandrinum, T. lappaceum, T. resupinatum* and to some extent *T. subterraneum.*

Group III : *T. pratense, T. medium, T. repens, T. hybridum* and *T. nigrescens.*

Group IV : *T. fragiferum* only.

Success in interspecific hybridization is more likely within a group rather than between groups. These results are in agreement with Collins and Taylor (1964) in putting *T. repens* and *T. nigrescens* in the same group and disagreed with them in placing *T. fragiferum* with *T. hybridum* and *T. medium* in one group and *T. pratense* with *T. subterraneum* in another group. This is also in agreement with Taylor and Keller (1968) who observed a close relationship between *T. pratense, T. lappaceum*, and *T. hirtum*, and it disagreed in putting *T. pratense* and *T. subterraneum* in one group.

Canavanine studies: The spots of canavanine on chromatographic paper gave magenta colour of varying intensity. These spots were graded according to the degree of intensity of their colours, and each of the 20 cultivars was given a numerical rank as presented in Table 4. It was found that the amino acid canavanine was present in all 20 cultivars with varying degrees of colour intensity which might indicate that quantitative rather than qualitative

TABLE 3. Ranking of 20 cultivars for the presence of amino acid canavanine in genus *Trifolium* L.

	Cultivar	Rank
1.	*T. alexandrinum* (Miskawi)	1
2.	*T. alexandrinum* (Khadrawi)	1
3.	*T. alexandrinum* (Seidi)	1
4.	*T. alexandrinum* (Fahl)	1
5.	*T. alexandrinum* (Hustler)	1
6.	*T. alexandrinum* (Wafir)	2
7.	*T. pratense* (Chesapeake)	2
8.	*T. pratense* (Kentucky)	4
9.	*T. pratense* (Tensas)	2
10.	*T. medium*	5
11.	*T. resupinatum*	5
12.	*T. subterraneum*	4
13.	*T. lappaceum*	1
14.	*T. fragiferum*	5
15.	*T. hirtum*	1
16.	*T. repens* (Nolin's improved)	5
17.	*T. repens* (La S—1)	2
18.	*T. repens* (Ladino)	3
19.	*T. hybridum*	5
20.	*T. higrescens*	2

differences exist between the cultivars used in this study. This was in agreement with Bell (1960) who detected canavanine in the seeds of 11 species of leguminous plants, and with Turner and Harborne (1967) who indicated the occurrence of canavanine in all species of *Trifolium* in their study. It is interesting to note that all six cultivars of *T. alexandrinum* gave quite faint colours which might indicate that they share a common, yet low, pool of the amino acid canavanine.

On the other hand, intervarietal variations in the degree of colour intensity were observed between the three cultivars of *T. pratense*, where the two cultivars, Chesapeake and Tensas gave faint colours while cultivar Kentucky gave a dark magenta colour.

Such variations were also noted between the three cultivars of *T. repens*. Nolin's improved gave (5), La 5—1 gave (2) and Ladino showed (3).

The existence of interspecific differences in the degree of colour intensity of canavanine appeared to indicate the significance of studying the amount of this amino acid as a tool in determining phylogenetic relationships in the genus *Trifolium*. This conclusion is in agreement with Bell (1958) who emphasized the role of this amino acid in this respect in his studies on species of leguminous plants.

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VEGETATION COVER OF THE DESERT RANGES BETWEEN FALLUJA AND THARTHAR LAKE IN CENTRAL IRAQ

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SUMMARY

The vegetation of the desert ranges along the newly established highway between Falluja and the southern shore of Tharthar Lake is discussed. The significant plant species and plant communities are recorded. *Artemisia herba-alba* and *Haloxylon salicornicum* build up a desert vegetation far from human settlements. In the villages near canals, in a wadi, and near the lake halophytes are growing such as *Aeluropus lagopoides, Bienertia cycloptera* and *Schanginia aegyptiaca.* Disturbed depressions and plains are occupied by *Artemisia scoparia* and *Salsola* species.

The biological significance of the vegetation and its applied uses are stated.

الخلاصـــــة

تم دراسة الغطاءالنباتى للمنطقة الواقعة على الطريق الحديث الواصل بين الفلوجة والساحل الجنوبى لبحيرة الثرثار ودونت الانواع النباتية والمجتمعات النباتية الرئيسة في المنطقة ٠

ان نباتى الشيح *Artemisia herba-alba* والرمث *Haloxylon salicornicum*

يكونان الغطاء النباتى الصحراوى في المناطق البعيدة عن الاماكن السكنية • تنمو في القرى وقرب القنوات وفي الوديان وبالقرب من ساحل البحيرة النباتات الملحية كالعجرش *Aeluropus lagopoides* والثليث *Bienertia cycloptera* والكاكوله *Schanginia aegyptiaca* ينمو على الفيضات والسهول المعكرة نبات السلماس *Artemisia scoparia* وانواع من جنس الروشـــة *Salsola spp.* .
ناقش البحث الاهمية البايولوجية للغطاء النباتى والاستعمالات التطبيقية له•

INTRODUCTION

The vegetation cover, an important environmental parameter, is an attractive subject to many ecologists and botanists all over the world. Recently, Walter (1971) and Zohary (1973) discussed in general some aspects of the flora and vegetation of Iraq. The purpose of our investigation is to give a general account about some ecological studies conducted in the area of the Mesopotamian plain between Falluja and the southern shore of Tharthar Lake. The adjacent desert ranges along the new canal between Tharthar Lake and the River of Euphrates are becoming very important for many agricultural purposes in the near future. The best form of habitat utilization should be found out upon ecological information of the area. Some suggestions are stated in this paper as a result of vegetation and habitat investigations based on many field trips during the last two years.

MATERIAL AND METHOD

A vegetation transect of about fifty kilometers was prepared by careful study of the significant permanent vegetation cover. Such investigation has been conducted along the newly established highway between Falluja and the southern shore of Tharthar Lake. Distances of the single spots investigated have been measured by the gauge of a car. The Thommen Everest Altimeter was used for measuring altitudes. Plants collected were stored at the Herbarium of the College of Agriculture in Abu-Ghraib (BUA). Identifications of plant species were checked by using different Iraqi Herbaria. The

abundance and cover of the species given in some sampling records were estimated by a modified method according to Oosting (1956) and Braun-Blanquet (1964). The convential 7-part scale combining the estimate of abundance and cover is as follows:

r = (very sparsely present).

+ = sparsely present, cover very small.

1 = plentiful but of a small cover value up to 5% of the area.

2 = very numerous, or covering at least 5% of the area.

3 = any number of individuals covering 25% — 50% of the area.

4 = any number of individuals covering 50% — 75% of the area.

5 = covering more than 75% of the area.

RESULTS

The vegetation of the plains and depressions between Falluja and the Tharthar Lake is subjected to an arid climate. Precipitation ranges between 75—150 mm and occurs mainly in winter and spring. Accordingly, the whole summer months are dry and hot (Walter, 1957 and Guest, 1966). The study area represents a part of the southernmost Lower Jazira. It is flat with some depressions and valleys. The elevations are between 38 and about 70 m. Even minor differences in moisture and elevation are ecologically important in a desert environment.

The vegetation profile begins at the road directly east of Falluja city close to the petrol filling station. The flat gypsum sand plains are very much affected by the misuse of man, residues of the original vegetation cover represented by *Zygophyllum propinqiium, Helianthemum lippii, Citrullus colocynthis, Fagonia bruguieri, Fagonia olivieri.* But significant nitrophilous plant species such as *Alhagi mannifera, Peganum harmala, Salsola incanescens* and *Cornulaca monacantha* indicate the ruderal effect in the vicinity of Falluja town.

Northwards follows the loamy depression of Saglawiya with its irrigation canals and high ground water level. It is covered by a complex of crop fields, date plam orchards and *Juncus rigidus* stands. *Phragmites australis* zones along old river beds and canals grow with high productivity. *Salix acmophylla* and *Populus euphratica.* occur beside,of the date palm orchards on water logged soils. On the ruderal and segetal habitats *Alhagi mannifera* is dominant in secondary communities. A sampling record may demonstrate the species combination on a fallow field (Table 1.).

North of human settlements wide haswa uplands, characterized by gypsum sand and covered with pebbles, are occupied by a *Cornulaca monacantha-Artemisia scoparia* community. The shrubby plants in spring are associated with many annuals covering the gypsum sand soil (Table 2).

The uplands are inhabited by an *Artemisia herba-alba-Poa sinaica* Community with an increasing participation of *Haloxylon salicornicum.* Especially close to the lake shore on hills and uplands, *Haloxylon salicornicum* and *Poa sinaica* increase in number. Sand mounds (hummocks) are locally

TABLE 1. *Schanginia aegyptiaca - Alhagi mannifera* Community.
Depression of Saglawiya north of Falluja, south of the road to Tharthar Lake, saline loam, fallow field, 100 sqm. 4—12—1974. Total cover: 75%.

Salt tolerant species		Halophytes	
Alhagi mannifera	4	*Cressa cretica*	2
Salsola baryosma	+	*Frankenia pulverulenta*	2
		Aeluropus lagopoides	+
		Schanginia aegyptiaca	+

TABLE 2. *Cornulaca monacantha - Artemisia scoparia* Community.

Plain 19 km north of Falluja, east of the road to Tharthar Lake, gypsiferous sand with gravel cover, 100 sqm. 10—4—1974. Total cover: 75%.

Shrubs			
Cornulaca monacantha	+	*Helianthemum lippii*	1
Moltkiopsis ciliata	1	*Convolvulus oxyphyllus*	1
Astragalus spinosus	1	*Ephedra alata*	1
Fagonia bruguieri	+	*Calligonum tetrapterum*	+
Achillea conferta	+		
Perennials & Biennials			
Artemisia scoparia	2	*Onobrychis bicolor*	+
Stipagrostis plumosa	+	*Launaea mucronata*	+
Heliotropium ramosissimum	+	*Allium desertorum*	+
Poa sinaica	1	*Peganum harmala*	+
Salvia spinosa	+	*Herniaria hemistemon*	1
Annuals			
Savignia parviflora	1	*Schismus barbatus*	1
Polypogon monspeliensis	1	*Astragalus schimperi*	1
Hordeum marinum	1	*Melilotus indicus*	1
Gymnarrhena micrantha	1	*Ceratocephalus falcatus*	1
Paronychia arabica	1	*Plantago ovata*	1
Leptalium filifolium	1	*Koelpinia linearis*	1
Helianthemum salicifolium	1	*Alyssum linifolium*	1
Medicago laciniata	1	*Bromus danthoniae*	1
Arnebia decumbens	1	*Anthemis wettsteiniana*	1
Stipa capensis	1	*Malcolmia grandiflora*	+
Heliotropium digynum	+	*Erodium deserti*	+
Cephalaria syriaca	+	*Cutandia dichotoma*	+
Schimpera arabica	+	*Malva parviflora*	+
Scabiosa olivieri	+	*Silena arabica*	+
Bromus tectorum	+	*Torularia torulosa*	+
Trigonella stellata	+	*Filago spathulata*	+
Lithospermum spinocarpus	+	*Erodium laciniata*	+
Calendula persica	+		

inhabited especially by *Haloxylon salicornicum* and *Sophora gibbosa* (Syn. *Ammothamnus gibbosus*). The vegetation unit of the upland in characterized by the same significant plant species (Table 3).

About 12 km south of the southern shore a broad wadi contains a mosaic of a sandy, grvelly, loamy sandy and even gravelly loamy saline soils. Due to this soil pattern this wadi is occupied at the slopes by an *Artemisia herba-alba-Poa sinaica* Community and also by plant communities predominated by *Aellenia hierochuntica* and *Haloxylon salicornicum*. The center of the wadi is covered by halophytes such as *Bienertia cycloptera, Schanginia aegyptiaca, Frankenia pulverulenta* associated with salt tolerant species such as *Aellenia hierochuntica, Halocharis sulphurea, Spergularia diandra, Alhagi mannifera* and even *Haloxylon salicornicum*. A related complex of plant communities covers the hills and depressions near the shore of Tharthar Lake. In the eroded crevices and small valleys close to the shore a *Salsola ruthenica — Aellenia hierochuntica* Community grows on a fine partly loamy sandy soil. On the shore flat at Tharthar Lake the vegetation cover of a halophytic *Tamarix passerinoides shrub community*. It is associated with *Aeluropus lagopoides Salsola rutheniea, Salsola incanescens, Salsola jordanica, Aellenia hierochuntica, Lagonychium farctum, Alhaji mannifera, Artemisia scoparia, Citrullus colocynthis* and *Eclipta alba*. Most of these plant species seem to be native along the shore of Tarthar Lake.

DISCUSSION AND CONCLUSION

The vegetation profile from Falluja to the Tharthar Lake shore shows different plant species combination and cover of various stands. The human influence and the misuse over centuries have had a serious effect on the distribution of the flora. In the vicinity of human settlements not only a ruderalization took place but also salination was going on causing the change of the original plant communities. The summer annual *Schanginia aegyptiaca* forms now in saline depressions a seasonal dense plant community. This

TABLE 3. Significant plant species of the *Artemisia herba-alba-Poa sinaica* Community in the studied area.

Shrubs	
Artemisia herba-alba	*Haloxylon salicornicum*
Salsola hainesii	*Noaea Mucronata*
Calligonum tetrapterum	*Convolvulus oxyphyllus*
Cornulaca monacantha	
Perennials	
Achillea conferta	*Poa sinaica*
Stipagrostis plumosa	*Teucrium olivierianum*
Diplotaxis harra	*Herniaria hemistemon*
Annuals	
Eremopyrum buonapartis	*Scabiosa olivieri*
Helianthemum salicifolium	

species seems to be one of the most important plants around the villages in Mesopotamia probably due to the following aspects:

1. Its ability to grow on slight saline and saline soils throughout summer time.
2. Its capability to accumulate soil salts in its tissues.
3. Its suitability to be utilized by the people in the countryside as fuel.
4. Its property for isolating houses and sheds against cold wind.

In the upland with gypsiferous sand and gravel *Stipa capensis* is locally dominating during spring on spots where shrubs and perennials have been destroyed. This is being an indication for a serious degradation. Overgrazed

vegetation is often preponderated by spiny shrubs such as *Astragalus spinosus, Convolvulus oxyphyllus,* and after a good moist winter by *Cornulaca monaacantha* (Agnew & Haines, 1960; and Agnew 1961—1962). The vegetation unit on the upland resembles a plant community described by Zohary (1973) as Association of *Artemisia herba-alba-Poa sinaica.*

The complex character of the habitat diversity at the hill side near the shore of Tharthar Lake is reflected to its vegetation mosaic. On the fresh weathered gypsum slopes of the shore hills and in the depressions several vegetation units are distributed:

1. A *Salsola canescens-Haloxylon salicornicum* Community on crude gypsum gravel soil (haswa).

2. *A Salsola canescens-Haloxylon salicornicum* Community predominated by *Stipagrostis plumosa* on wind-blown exposed upper gypsum flanks.

3. A *Salsola ruthenica-Aellenia hierochuntica* Community in small valleys on a fine, partly loamy sand soil.

4. The halophytic *Tamarix*-Community of the shore near the lake which consists of halophytes, salt telerant, ruderal plants mixed with nitrophilous elements of the desert vegetation. Here the *Tamarix* shrubs are cut nowadays and transported by lorries to Falluja as a fuel. This deterioration process is increased by the new established highway from Falluja to the lake.

In general, the vegetation of the study area is deteriorated by many factors such as the mentioned fuel gathering, overgrazing and even dry farming (Al-Ani & Hadad, 1973). A proper range management may lead in future over conservation and a suitable utilization for animal feeding to better yields of this environment (Al-Khateeb, 1973). The plains and the depressions of this area are fit for an agricultural utilization, in particular for

crop cultivation, if the necessary water supply for irrigation and drainage will be provided. The main interest for land reclamation and improvement of the agricultural productivity ought to be focused now to the plains and depressions near Falluja and Saglawiya where plants like *Artemisia scoparia* indicate almost salt free or less salty loamy arable land.

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A NOTE ON STUDIES ON FLOWER OPENING AND ANTHER DEHISCENCE IN PEANUTS

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Crop improvement in self-fertilised crops, can be brought about by pure line selection or hybridisation followed by selection. In the case of oilseed crops, it is possible to increase yield well as oil percentage. Among these crops, peanuts (also known as groundnut), occupy an important place in the world market, as a source of edible vegetable oil.

Under varietal trial ten varieties were selected for the year 1971. In the subsequent year two varieties, namely, "China 31" and "Russian 35" were replaced by 5 new varieties *viz* N.C., N.C. 4—x, N.C. 2, S.F. 42 and C.P. 1443. In other words, there were 10 and 13 varieties for the years 1971 and 1972 respectively. The study helped to get information on the subject and provide specific data on variety/varieties, likely to go into future breeding programmes.

Preliminary studies taken up prior to actual data colletion, indicated that flower opening and anther dehiscence started in all varieties past mid-night and that in no two varieties it started at the same time. Consequently, a close examination of the bud almost an hour before the likely time of flower opening and anther dehiscence was started and the flower buds were marked earlier. Plants were selected from the border rows and

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observations were recorded with the help of hand lenses, field microscopes etc. Time of anther dehiscence was noted when the pollen sac burst on being slightly touched with the tip of forceps. For both years, the observations were recorded in the field. The average of a large number of observation was obtained. It may be mentioned that in a study of this kind, one could expect some variation on account of personal error of judgement.

The flower opening in all the varieties followed the same pattern, it started 15 minutes to half an hour after anther dehiscence, although in one or two cases it showed signs of opening even before anther dehiscence. No specific data was recorded of it, since such a knowledge would not materially aid in the breeding progamme. These results are in confirmity with those of Hassan and Strivastava (1966) who reported that flower opening, by and large, coincided with anther dehiscence.

The data on the commencement of anther dehiscence is presented in the table below:

Time of Anther Dehiscence

No.	Variety	1971	1972
1	Giza	5.05 a. m.	4.10 a. m.
2	China 31	2.55 ,,	—
3	China 32	2.15 ,,	2.00 a. m.
4	Russian 34	3.30 ,,	3.00 ,,
5	Russian 35	2.15 ,,	—
6	Russian 37	3.50 ,,	2.50 ,,
7	Sudani 38	4.15 ,,	4.15 ,,
8	Sudani 39	4.30 ,,	3.45 ,,
9	China 40	4.00 ,,	3.50 ,,
10	Indian 41	—	2.30 ,,
11	S.P. 42	—	3.15 ,,
12	N.C. 4—X	—	4.00 ,,
13	N.C. 2	—	3.40 ,,
14	C.P. 1443	—	2.15 ,,

The results indicate that in no two varieties the anther dehiscence took place at the same time although the varieties which came from climatically similar origin anther dehiscence fell in a closer range. For example, it occurred from 2.00 a. m. to 4.00 a. m. in varieties of Chinese and Russian origin, while in the case of varieties from Sudan and Egypt, the time was from about 3.00 a.m. to 5.00 a. m., of course the results can by no means be taken as rigid, nevertheless, these do give a fairly accurate idea of the time of anther dehiscence.

Still another interesting fact which came to light, was that the time of anther dehiscence was not the same even the same variety over the two years; being earlier in 1972 as compared to 1971. The varieties where the anther dehiscence took early in 1971, continued to do so in 1972. In other words, the sequence was maintained. These findings are at variance with those of Hassan and Strivastava (1966). In their studies, the anther dehiscence took place in all the varieties from 5.00 a. m. to 6.00 a. m. The difference can be explained by the fact that the varieties in the present study were different from those of Hassan and Strivastava (1966). Still another factor more important than the first, may be the different agro-climatic condition under which the two experiments were conducted. That these factors, especially humidity, play an important role in flower opening and anther dehiscence in plants, have been shown by similar studies conducted on Egg plant (Pal and singh, 1943). Even Hassan and Strivastava, while discussing their findings, vis-a-vis those of Seshadri (1962) who reported flower bud opening in peanut from 6.00 a.m. to 800 a. m. stated " it probably suggests that environmental factors play role in the flower opening".

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