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# EFFECT OF FERTILIZERS ON THE YIELD OF FLAX AND ON THE OIL AND PROTEIN CONTENT OF THE SEED

Hasan Abdul Kareem

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## SUMMARY

In a randomized field plot study on fertilization of Marakichi flax, nitrogen applied alone or in combination with phosphorus and potassium, gave a pronounced increase in yield but only a slight increase in percentage of oil and protein in the seed. Phosphorus had no effect on yield but increased the oil content of the seed. Potassium, either in presence or absence of nitrogen, depressed the yield and had little or no effect on protein content of the seed.

## الخلاصة

لوحظ في الدراسة الحقلية بالالواح لتسميد الكتان المراكشي على الطريقة العشوائية ان استعمال النتروجين بمفرده أو مع الفوسفور والبوتاسيوم أعطى زيادة محسوسة في الانتاج وزيادة طفيفة في نسبة الزيت والبروتين في البذور. ولوحظ ايضا ان اضافة التوسفور لم تسبب زيادة في الناتج ولو أنها أزدت من نسبة الزيت في البذور. اما البوتاسيوم فانه قلل الناتج ولم يؤثر أو أثر قليلا في نسبة البروتين في البذور عندما استعمل لوحده أو مع النتروجين.

## INTRODUCTION

Flax is one of the oldest of cultivated crop plants and is indigenous to the Mediterranean region. It thrives best in the temperate zone, with an annual rainfall between 18 and 30 inches. It is also grown in arid regions under irrigation. It fits well into rotation with legumes and small grains.

Flax is grown for both seed and fiber. The seed has been reported by Miller (1938) and Martin and Leonard (1953) to have an oil content ranging between 30 and 44%. Its oil content is less than that of castor, peanut, sesame and sunflower, but considerably

higher than that of soybean and cottonseed. Production of the oil in Iraq in 1962 was 120 tons. A large amount of flaxseed is presently being imported into Iraq from foreign countries. It is a source of profit to our country and its production can be greatly increased.

Flaxseed oil is used in the production of such well-known products as paint, linoleum, oil cloth, printer's ink and soap. Flaxseed meal is used to some extent as feed for livestock. The straw is used in the manufacture of linen cloth and high-grade paper as report by Martin and Leonard (1953).

Flax is well suited to Iraq soil conditions, since it can tolerate moderate salinity.  $EC \times 10^3$  between 6 and 10. (Richards, 1954, p. 67). The cultivated area for flax production has increased in Iraq since 1959, as shown by official figures issued by the Central Bureau of Statistics, Ministry of Planning of the Republic of Iraq (1963), which are given in Table 1.

**Table 1. Statistics on flaxseed production in Iraq, 1959—63**

Year	Cultivated	Total	Reported Yield
	donums *	tons	kg./donum
1959-60	34,000	4,700	138
1960-61	36,100	4,800	133
1961-62	47,700	6,600	138
1962-63	47,100	6,200	132

The data in Table 1 show that the annual yield of flax per donum is tending to decrease. Since flax is a crop of great potential value to Iraq, it was decided to do some

research to find out the extent to which the yield of seed and straw and the amount of oil and protein in the seed could be increased by use of chemical fertilizers.

#### MATERIALS AND METHODS

The study here reported was exploratory in nature, to discover the possibilities. Only one level of each nutrient was chosen and the effects of these nutrients studied singly and in presence of each other. The amounts of the fertilizers used were as follows:

*Nitrogen*: 100 kg. Ammonium sulfate (21%N) per donum.

*Phosphorus*: 120 kg. Ordinary superphosphate (18% $P_2O_5$ ) per donum.

*Potassium*: 50 kg. Potassium sulfate (50% $K_2O$ ) per donum.

The experiments were conducted on the College Farm at Abu Ghraib. The soil was a silty clay loam having a paste pH value of 7.5, a salt content equivalent to an  $EC \times 10^3$  of 4 millimhos per cm., and a total nitrogen content of 0.007%. These determinations were made according to the methods of Richards (1954) and total nitrogen by Kjeldahl distillation of ammonia according to Piper (1950).

The plots were 10 sq. m. each in area, and randomized. The

\* Donum=2500 square meter or about 0.6 Acre.



treatments were replicated six times. Irrigation was by the basin method and the water measured by parshall flume. Total amount of water received by each plot was 18.5 inches, of which 12 inches were irrigation water and 6.5 inches from rainfall. (Ministry of Communications, Republic of

Iraq, 1963). The irrigation water was applied in six applications one every two weeks. The seed, which was of the Marakichi variety, was planted in October, 1963. Both the seed and the entire amount of fertilizer needed for each plot were broadcast at planting time.

### RESULTS

The results of the experiment are given in Table 2.

**Table 2. Yield and composition of flaxseed in relation to Fertilizer applied**

Treatment	Fertilizer applied			Average Height of Plants at Maturity	Average Yield of Seed	Composition of Seed	
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O			Oil	Protein
	kg./donum			cm.	kg./donum	%	%
Check	0	0	0	40	146	33.3	19.8
N alone	21	0	0	80	349	37.2	18.6
P alone	0	22	0	50	144	38.2	19.4
K alone	0	0	25	40	130	34.2	20.1
N+P	21	22	0	70	239	35.6	17.0
N+K	21	0	25	60	245	36.7	18.2
P+K	0	22	25	35	123	37.2	18.2
N+P+K	21	22	25	65	246	33.2	18.6

### DISCUSSION

#### 1. Effect of fertilizers on yield of flax.

In every case where nitrogen was applied, either alone or in presence of phosphorus or potassium, there was a pronounced increase in yield. This increase ranged from 60 to 140% over the yields obtained on the untreated plots. This response supports the generally accepted fact that nitrogen is deficient in Iraq soils. The native nitrogen content in this soil, reported earlier in

this paper to be 0.007% and which amounts to about 77 kg. of nitrogen per donum at 30 cm. depth, is very probably in organic form and not readily available to the plant.

The effect of phosphate on seed yield was only slight or negligible, whether added alone or in presence of nitrogen or potassium. Since no response to added phosphorus was obtained, it may be concluded that the amount of



available phosphorus naturally present in the soil was adequate. This result is in agreement with those of Kareem and Russel (1957; 1965).

Potassium, either in the presence or absence of nitrogen, showed a *depressive effect* on seed yield. This depressive effect of potash has been frequently observed by investigators working with cereals in various countries. It is generally believed that potassium is not deficient in Iraq Soils. This depressive effect is probably more likely to result

from a nutrient imbalance caused by adding potassium rather than a toxic effect of potassium. This effect needs to be explained by the plant physiologists. In any event these results show that it may be neither wise nor economical to apply potash fertilizer to a flax crop in Iraq.

The growth response of flax to the fertilizers here applied is also indicated by the average height of the plants at maturity, as recorded in Table 2 and illustrated by the photographs in Figures 1 and 2.

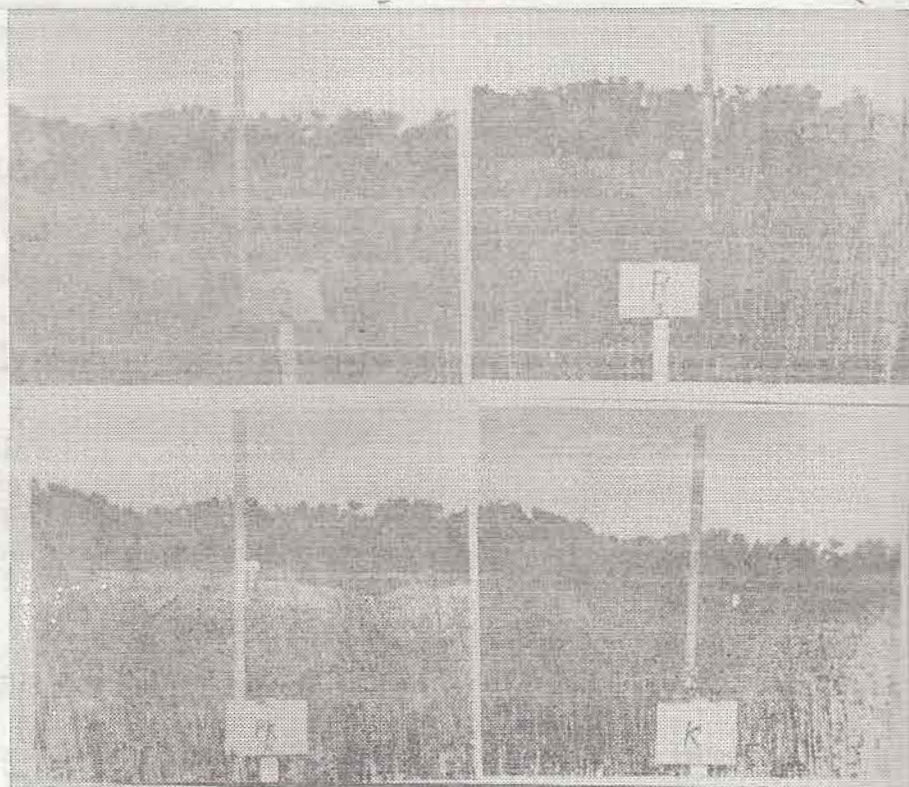


Fig. 1. Views showing density of stand and height attained by flax plants at maturity when fertilized with phosphorus alone, with potassium alone, with phosphorus and potassium, as compared with the control.



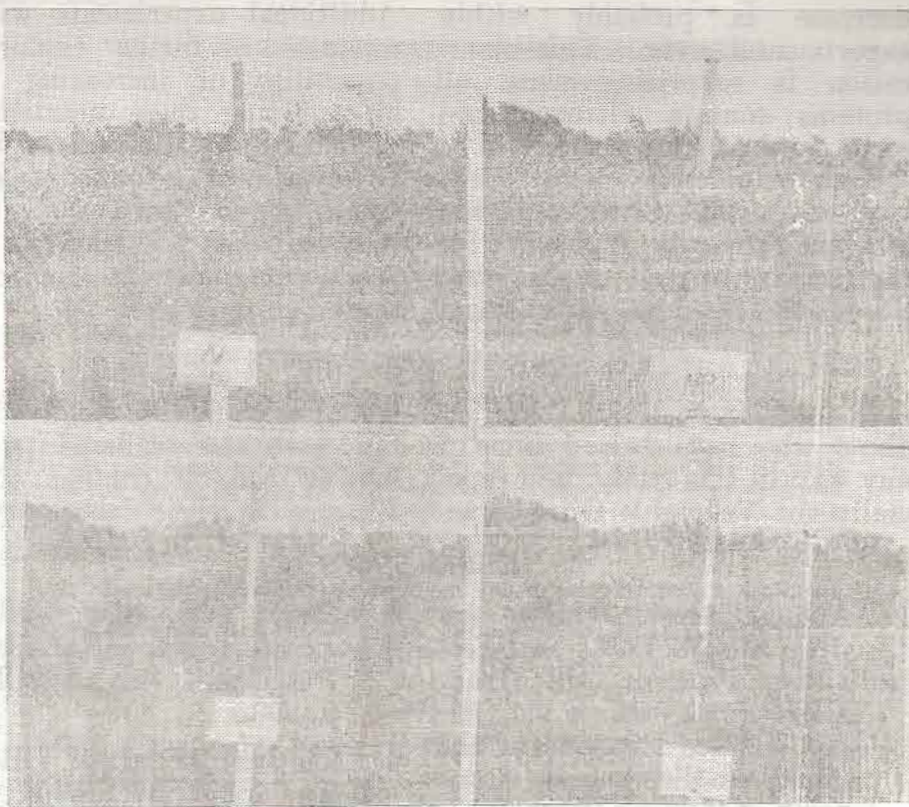


Fig. 2. Views showing high response to fertilization with nitrogen alone, nitrogen and phosphorus, nitrogen and potassium, and all three nutrients, of flax at maturity.

## 2. Oil content of the seed.

Nitrogen, phosphorus and potassium generally increased the oil content of the seed over that of the check plots. Only in the case where all three nutrient elements were added as fertilizer, was no increase observed. Reuther, Embleton, and Jones (1958) point out that potassium increases the oil content of nuts and oil-seeds. Miller (1958) states that the oil in the seed of oil-bearing plants

is formed by conversion of carbohydrates to glycerine and fatty acids is related to potassium metabolism. The function of potassium is apparently to catalyze this transformation.

## 3. Effect of added nutrients on protein content of flaxseed.

The effect of nitrogen, phosphorus and potassium on the protein content of the flaxseed was either nil or these nutrients tend to decrease the protein



content slightly. However, the decrease is probably within experimental error. This observation is surprising since all proteins contain nitrogen and some contain phosphorus also.

This exploratory experiment has shown that nitrogen is the nutrient primarily responsible for the increase in yield of flaxseed; phosphorus has no effect, and

potassium tends to decrease it. Additional experiments will be conducted to further explore the possibility of increasing yield by applying these nutrients at increasing rates, especially nitrogen, and to determine costs and returns, and hence the profits that may be realized from flax production under irrigated conditions.

#### ACKNOWLEDGEMENTS

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tion Company of Baghdad for kind assistance rendered in determining the oil content of the flaxseed in their laboratory.

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## XANTHINE-ALDEHYDE DEHYDROGENASE IN MILK AND MILK PRODUCTS

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### SUMMARY

The ability of the enzyme xanthine oxidase to catalyze the oxidation of hypoxanthine and xanthine into uric acid was used as a technique to determine the units of xanthine oxidase in some milk and milk products. Best results were obtained when the pure xanthine oxidase was diluted at the rate of 1:100 by volume before absorbance readings could be taken.

Pure xanthine oxidase was found to contain 1093.90 units per ml while pasteurized skim milk showed to contain 10.5 units per ml. Raw cream of 30% fat was found to contain 327.6 units of xanthine oxidase per ml while frozen raw cream of 35% fat and pasteurized cream of 30% fat were found to contain 136.5 and 52.6 units of xanthine oxidase per ml respectively. Raw whole milk of 5% fat was found to contain 134.4 units per ml while pasteurized oxidase per ml.

It was concluded that pasteurization and freezing caused a decreasing effect on the content of xanthine oxidase of milks and milk products. This effect needs to be investigated further because of its direct relationship to the stability of fat in milk and milk products.

### الخلاصة

لقد أجرى هذا البحث لتقدير كمية الانزيم المسمى ( زانثين اوكسيديز ) في الحليب ومنتجات الحليب نظرا لاهمية هذا الانزيم بالنسبة الى بعض الصفات التي تحملها الجزيئات الدهنية الموجودة في الحليب . تشير النتائج الى أن الحليب الغرز الخالي من الدهن يحتوي على حوالي ١٠٩٥ وحدة من الوحدات القياسية لهذا الانزيم بينما وجد بأن الكريم المحتوي على ٣٠ % دهن يحتوي على ٣٢٧.٦ وحدة قياسية من هذا الانزيم . كما وأن النتائج تشير الى أن تعقيم الكريم وتجميده يؤدي الى قلة كمية هذا الانزيم . وبصورة عامة يمكن أن يقال بأن كمية الانزيم تتوقف على نسبة الدهن والمعاملات التي يتعرض اليها الحليب أثناء الصناعة .

### INTRODUCTION

A number of enzymes have been isolated and identified from the milk fat globules membrane. Among those was xanthine-aldehyde dehydrogenase.

The oxidation of hypoxanthine and Xanthine to uric acid in the presence of oxygen was first recognized in 1889 by Spetzer and the enzym involved

was named xanthine oxidase according to Ball (2). Sharp (12) stated that whole milk showed to contain about 0.07 g. of the xanthine oxidase per 100 g. of fat. Greenbank (7) reported that one liter of milk contained 160 mg of xanthine oxidase as it was determined by the reduction of methylene blue using hypoxanthine as a

substrate. King (11) stated that the presence of xanthine oxidase in the membrane material of the milk fat globules was repeatedly demonstrated by Schwartz in 1929. Toyama in 1933. Schwartz and Fisher in 1937 and Polonviski in 1949.

Kielly (10) developed a technique which was used to purify xanthine oxidase from calf liver. Bradley and Gunther (3) determined xanthine oxidase in human milk and colostrum by using anaerobic reduction of 2:3:5 triphenyl tetrazolium chloride at pH 9.4.

The characteristics and composition of xanthine oxidase have been under investigation for many years. Ball (2) found the isoelectric point of the enzyme at pH 6.2 and the molecular weight was estimated as 7400. Haseeker and Heppel (9) found that xanthine oxidase can reduce cytochrome in presence of hypoxanthine xanthine or acetyl aldehyde. Hafstee (8) found and reported that the activity of xanthine oxidase is decreased with increase in the substrate concentration which is in contrast to the

behavior of most enzymes.

Zittle et al. (14) showed that the inhibition of xanthine oxidase depends on the concentration of the substrate.

Aurand and Wood (1) reported that the enzyme is considered to be an aerobic dehydrogenase. It reacts directly without the intervention of hydrogen carriers. It contains iron and molybdenum and the ions of these metals are essential for the activity of the enzyme. They believed that the development of spontaneous oxidized flavor in milk could be correlated to xanthine oxidase activity. They proved that it was caused by a single enzyme rather than a multi-enzyme system. Bray et al. (4) reported that the iron content of the enzyme exists in the ferrous state. Burrell and Bray (5) stated that heavy metal inactivation, photooxidation and gross denaturation were the three mechanisms which caused inactivation of xanthine oxidase.

The purpose of this research is to compare the xanthine oxidase content of ice cream with some other milk and milk products.

#### EXPERIMENTAL PROCEDURE

The technique used for the determination of xanthine oxidase in milk and milk products is the same as that used by Zittle et al. (14).

##### Reagents:

1. Triphenyl Tetrazolium chloride (TTC). A 0.35 M, or 334.5 mg. is dissolved in 20.0 ml. of 0.1 M sodium phosphate buffer of pH 7.5.
2. Xanthine, 0.005 or 0.05 M solution prepared by dissolving 380.0 mg. in 50.0 ml. of 0.05 N NaOH.
3. Phosphate buffer, 0.5 M, pH 7.5 prepared by dissolving 29.1 g. of  $\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$



and 2.28 g.  $\text{NaH}_2\text{PO}_4$ .  
 $\text{H}_2\text{O}$  in water and making the  
final value 250 ml.

4. Glacial acetic acid.

**Procedure :**

1. The reaction was carried out in a water bath at  $30^\circ\text{C}$  in 125 x 15 mm. test tubes.
2. 1.0 ml. of 0.5 M sodium phosphate buffer pH 7.5, 0.2 ml. xanthine solution and 1.5 ml. of distilled water were mixed in the test tubes duplicated.
3. Bubble commercial nitrogen gas through small capillaries extended to the bottom of the test tubes. Continue bubbling for 5 minutes then add 1.0 ml. of diluted milk, or skim milk or cream. The milk was diluted 1:5 and the cream was diluted 1:20, except to the control.
4. Continue bubbling for 5 minutes then 0.2 ml. of TTC and the reaction was continued for 10 minutes.
5. The reaction was stopped with the addition of 5.0 ml. of Glacial acetic acid.
6. Add 4 ml. of Toluene, stopper the test tubes and shake vigorously. Centrifuge at 2000 R.G.N. for 10 minutes then take 2 ml. of the toluene extracted color and dilute with 4 ml. of Toluene. Use this volume for spectrophotometer readings.
7. The Bausch and Lomb Model 340 was used for spectrophotometer readings at 485 mu. and results of absorbance readings were recorded.
8. The units of xanthine oxidase found in milk and milk products were estimated as each 0.105 absorbance = 10.5 units xanthine oxidase per ml.

**Milk and Milk Products Examined**

1. Pasteurized skim milk
2. Pasteurized whole milk
3. Frozen raw cream of 35% fat
4. 10% coffee cream
5. 12% ice cream
6. Precipitate from 12% ice cream prepared according to procedure reported by Dixon and Thembow (1924).
7. Raw whole milk 5% fat
8. Raw skim milk 2% fat
9. Raw cream 20% fat
10. Whipping cream

# Results :

**Table 1. Xanthine oxidase content of some milk and milk products.**

Product Examined	Rate of Dilution	Spectrophotometer Readings	Factor	Units of xanthine oxidase per ml. each 0.105=10.5 units
Pasteurized skim milk	1:5	0.01	11	10.5 units
Pasteurized whole milk 3.4% fat	1:5	0.02	11	21 unit
Frozen raw cream 35% fat	1:20	0.05	26	136.5 units
Pasteurized cream 30% fat	1:20	0.02	26	52.6 units
10% Pasteurized coffee cream	1:20	0.02	26	52.16 units
12% ice cream	1:20	0.02	26	52.16 units
Precipitate from 12% ice cream	1:20	0.03	26	81.9 units
Raw whole milk 5% fat	1:10	0.08	16	134.40 units
Raw partly skimmed milk 2% fat	1:5	0.03	11	33.0 units
Raw cream 30% fat	1:20	0.12	26	327.60 units
Whipping cream Pasteurized 20% fat	1:20	0.02	26	52.16 units
Control	0.00	0.00	0.00	0.00 units
Pure xanthine	1:100	1.00	106	1093.00 units



**Table 2. Distribution of xanthine oxidase and alkaline phosphatase in cream, skim milk and fractions of butter.**

Products Examined	Xanthine oxidase content units/ml.	Alkaline phosphatase content units/ml.
Cream	143	400
Skim milk	23	88
2.3 M Precipitate	10	22

## RESULTS AND DISCUSSION

The results obtained are reported in Table 1. These results show that pasteurized skim milk contained 10.5 units of xanthine oxidase per ml while raw cream contained 327.60 units per ml. This is a definite proof that the enzyme is associated with the milkfat globules. They also show that products exposed to pasteurization contain less of the enzyme than those without pasteurization. Zittle et al. (13) studied the distribution of xanthine oxidase in some milk products. Their results are reported in Table 2. They also reported that skim milk obtained from aged whole milk at low temperature showed to contain more xanthine oxidase than skim milk obtained from fresh whole milk. Frozen raw cream containing 35% fat showed to con-

tain 136.5 units of xanthine oxidase while fresh raw cream showed to contain 327.60 units per ml. This is in accord with the finding of King (11) who stated that the link between the enzyme and the membrane material can be altered by freezing. It was also found that raw whole milk 5% fat contained 134.40 units of xanthine per ml while pasteurized whole milk of 3.4% fat showed 21 units of xanthine oxidase per ml. Greenbank (7) reported that the xanthine oxidase of cream showed more resistance to heat than that of whole milk. He also stated that heating milk to 160°F for 50 minutes does not entirely inhibit methylene blue reduction. Heating of cream of 40% fat to 170°F for 35 minutes does not destroy all the activity of the enzyme.

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## DURUM WHEAT VARIETY TRIALS IN IRAQ

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### SUMMARY

A varietal yield test for four years indicated that durum wheat is quite adaptive to the middle irrigated Region of Iraq. It has highly exceeded the local Adjeba bread wheat in average yield production. Baharia 22 and Italian 1304 were promoted to foundation seed due to their yielding ability and promising agronomic characteristics as compared to the local durum wheat Sourah-Kool.

### الخلاصة

في تجربة مقارنة حاصل أصناف مدة اربع سنوات ، ادخل صنفان من الحنطة الخشنة هما بهارية ٢٢ وايطالية ١٣٠٤ في مرحلة تكثير البذور الاساسية وكان هذان الصنفان ملائمين للمنطقة الاروائية الوسطى .

### INTRODUCTION

Durum wheat is restricted to the northern dry farming Region of Iraq, and never been used in the central or southern irrigated Regions. It was thought it was necessary to collect information on the adaptability of a few introduced and local durum wheat varieties in the central Region, in order to be able to select the suitable varieties for the use in the future in central and southern Regions, which are very much alike in environmental conditions.

Cook and Pendleton (1,6) have obtained high yielding varieties of wheat by subjecting a large number of varieties to comprehensive varietal trials.

Elliot, Darroch and Wang (3) reported that three and four row plots, from which the central row

or rows were harvested for yield tests have been generally used in grain trials. Down (2) suggested the use of five row plots for winter wheat, discarding the outside rows in each case.

Weibe (8) found that the long, narrow plot was less variable than a square one of the same area. Johnson and Murphy (4) used 16 foot long plots.

As the plot size increased, the estimated number of replications decreased and the average minimum number of replications required to reduce the standard error of the mean to 5% was three (3).

In all varietal trials of cereals the guard rows were discarded upon harvesting the plots. Veatch (7) removed in addition to border rows



one foot from each end of the central rows in wheat trials.

Lande (5) reported that comparative yield of wheat varieties in many instances did not remain constant during a long period of

testing. This perhaps was due to changes in environment (meteorological, biological and nutritional factors), changes in the varieties under investigation or interaction of environment and varieties.

### MATERIALS AND METHODS

Fourteen foreign and local durum wheat varieties were placed out in a randomized block design, with four replications, and conducted at the Abu Ghraib irrigated Station for four years (1957 to 1960) for studying yield and other agronomic characteristics. Each variety was planted in four rows, 30 cm. apart and 5 meters long. The date of planting was approximately in the middle of November each year. The rate of seeding was 32 Kg. per acre. In addition to border rows, 50 cm. from each end of the middle rows were eliminated to avoid border effect. Harvesting was done by hand and threshing was done by small motor driven nursery thresher. Field and laboratory characteristics were studied from the central rows by using the following procedure:

- a) Heading date: March 26 to March 29, early (E); March 30

to April 3, medium (M); and after April 3, late (L).

- b) Maturity date: May 4 to May 5, early (E); May 6 to May 7, medium (M); and May 8 to May 9, late (L).
- c) Height: 110 to 116 cm. short (S); 117 to 123 cm. medium (M); and 124 to 130 cm. tall (T).
- d) Cold resistance was estimated visually on percent basis.
- e) Lodging was estimated on a scale of 1 to 10 with (1) being most resistant to lodging.
- f) Glume pubescent (P) versus glabrous glume (G).
- g) Weight in gram per 100 seeds.
- h) Yield converted in bu/acre and analysed statistically according to the method of analysis of variance.

### EXPERIMENTAL RESULTS

Cold resistance, heading date, height in centimeter (cm.), lodging score, maturity date, awns color, pubescent versus glabrous glume, glume color, seed color, and weight per 100 seeds in gram were studied yearly for each variety. The results are presented in Table 1.

The average yield analysis of variance from 1957 to 1960 gave significant difference between years, varieties, and years x varieties, which indicated that varieties responded differently in different years. There was no significant difference among years (Y1, Y3 and

Table 1. Field and laboratory characteristics of durum wheat varieties, 1957 to 1960.

No.	Variety Name	Origin	Cold resistance	Heading	Height cm.	Lodging score	Maturity	Awns color	Glume pubescence	Glume color	Seed color	Weight per 100 seeds gram	Average yield bu/acre
1.	Baharia 22	Local	100%	M	M	3.0	M	Black	P	White	Light Red	4.2	30.16
2.	Sourah-Kool 74	Local	100%	E	M	6.0	E	Brown	P	Brown	Light Red	4.3	26.36
3.	Valmorán 1080	U.S.A.	100%	L	T	2.0	L	Black	G	Brown	Light Red	3.9	24.20
4.	Syrian 1338	Syria	100%	M	S	6.0	M	Black	G	Brown	Light Red	4.1	26.60
5.	Italian 1304	Italy	100%	E	M	2.0	M	Black	G	White	Light Red	4.4	29.73
6.	Roush Kool 72	Local	100%	E	S	6.0	M	Black	G	White	Light Red	3.7	26.87
7.	Pentand 1459	U.S.A.	100%	L	M	2.0	L	Brown	G	Brown	Light Red	3.4	23.03
8.	Ld. 246 x Ld. 320 Carleton 354-1479	U.S.A.	100%	L	M	2.0	L	White	G	White	Light Red	3.6	25.58
9.	Reydawiah	Local	100%	M	S	5.0	M	Brown	P	Brown	Light Red	4.2	26.85
10.	Moroccan 1083	Morocco	100%	L	M	2.0	L	Brown	P	White	Light Red	4.9	25.99
11.	Kableyli 1339	U.S.A.	100%	M	T	5.0	L	Brown	G	White	Light Red	4.4	25.70
12.	Baladi 1309	U.A.R.	90%	E	S	5.0	E	White	G	White	Red	3.6	29.63
13.	Timilia S-G. I-T-D 1360	U.S.A.	100%	L	S	2.0	L	White	G	White	Red	2.7	25.56
14.	Amario Bianco Tipo 142-1473	U.S.A.	100%	E	T	5.0	E	Brown	G	Brown	Light Red	3.4	30.34



Y4), which shows that only Y2 was exceptional. The varieties mean square significantly exceeded the varieties x years interaction mean square, indicating that some varieties were superior to others (Table 2). Duncan's range test indicated that there was no significant difference among varieties, however, varieties No. 14; Amario Bianco Tipo 142—1473, No. 1; Baharia 22, No. 5; Italian 1304 and No. 12; Baladi 1309 showed 115.10%, 112.78% and 112.44%, respectively average increase in yield of No. 2; check Sourah-Kool 74 which is one of the main local durum wheat variety in the northern dry farming Region. Only varieties 1 (Baharia 22), and 5 (Italian 1304) were promoted to foundation seed, because they showed better agronomic characteristics than varieties 14, 12 and 2 (Table 1). There was no correlation between average yield and weight per 100 seed, ( $r=0.121$ ).

### DISCUSSION

The Iraqi farmer so far, has not planted durum wheat in the middle irrigated Region. This test indicated clearly that durum wheat varieties are quite adaptive to the middle irrigated Region of Iraq, since its average yield per acre was quite double the average yield of local\*\* Ajeba bread wheat, which is the only local variety planted in this region, and about equal to the barley\*\*\* average yield. Out of

this study two varieties of durum wheat namely, Baharia 22 and Italian 1304 were promoted to foundation seed since they gave 114.42% and 112.78%, respectively higher yield than local Sourah-Kool 74. These varieties did not differ significantly in yield from Sourah-Kool, but were superior in quite a few promising agronomic characteristics.

\*\*W.S. El-Shamma. Bread Wheat Varietal Trials in Iraq. *Proceeding of the Iraqi Sci. Soc.* 6 : 26—33, 1965.

\*\*\*W.S. El-Shamma. Barley Varietal Trials in Iraq. *Proceeding of the Iraqi Sci. Soc.* 6 : 12—15, 1965.

Table 2. Yearly average yield bu/acre and percentage increase of durum varietal test.

No.	56—57	% of check 57—58	— X Y <sub>1</sub>	— X Y <sub>2</sub>	— X Y <sub>3</sub>	— X Y <sub>4</sub>	% of check 58—59	% of check 59--60	Average % of check	Grand X	% of check
14	26.83	101.90	10.08	142.37	38.37	107.99	46.08	126.25	119.63	30.34	115.10
1	32.92	125.03	9.50	134.18	34.97	98.42	43.25	118.49	119.03	30.16	114.42
5	33.42	126.93	8.99	126.98	35.35	99.49	41.17	112.79	116.55	29.73	112.78
12	28.35	107.67	6.74	95.20	35.70	100.48	47.75	130.82	108.54	29.63	112.44
2	26.33	100.00	7.08	100.00	35.53	100.00	36.50	100.00	100.00	26.36	100.00



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**EFFECT OF VARIOUS SALT CONCENTRATIONS ON  
CROWTH OF *FUSARIUM OXYSPORUM* F. *LYCOPERSICI*  
SACC. AND *RHIZOCTONIA SOLANI* KUHN**

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**SUMMARY**

Influence of various concentrations of NaCl,  $MgCl_2$ , and  $Na_2SO_4$  on growth of *R. solani* and *F. oxysporum* was studied. It was found that :

1. There was no significant effect on growth of *F. oxysporum* by NaCl up to 0.855 molal, but higher concentrations reduced growth of this fungus.
2. *R. solani* was more sensitive to NaCl than *F. oxysporum*.
3. There was negative relationship between growth of the two fungi and  $MgCl_2$  concentration.
4. Growth of *F. oxysporum* was influenced more by  $Na_2SO_4$  than by NaCl, although the osmotic pressure produced by  $Na_2SO_4$  is lower than that produced by NaCl at the same concentration.
5. Both salt concentration and the specific effects of its ions influenced growth of fungi in this study.

**الخلاصة**

يتعلق موضوع البحث بتأثير تراكيز مختلفة من كلوريد الصوديوم وكلوريد المغنسيوم وsulfates الصوديوم على نمو الفطر *Fusarium oxysporum* والفطر *Rhizoctonia solani* حيث وجد الآتي :

- ١ - لم يكن هناك تأثير مهم لكلوريد الصوديوم على نمو *F. oxysporum* الى تركيز ٨٥٥\* جزئى وزنى ولكن التراكيز الاعلى من هذا التركيز قللت من نمو هذا الفطر .
- ٢ - كان *R. solani* حساسا لكلوريد الصوديوم أكثر من *F. oxysporum*
- ٣ - كان هناك علاقة عكسية بين نمو الفطرين وتركيز كلوريد المغنسيوم .
- ٤ - تأثر نمو *F. oxysporum* بسلنات الصوديوم أكثر من كلوريد الصوديوم ولو أن الضغط الأزموزى الناتج عن سلنات الصوديوم هو أقل من ذلك الناتج عن كلوريد الصوديوم بنفس التركيز .
- ٥ - كان هناك تأثير لكل من تركيز الملح والتأثيرات الخاصة لايوناته على نمو الفطرين فى هذه الدراسة .



## INTRODUCTION

Soil fungi causing plant diseases must have certain abilities to exist under unfavorable conditions. It was pointed out by Cochrane (1958) that tolerance of fungi to low relative humidity appears to be associated with tolerance to high osmotic pressure. Brancato (1954) found that *Aspergillus* can grow on media with osmotic pressure more than 100 atm. Thatcher (1939) showed that osmotic pressure of fungous plant pathogens is greater than that of hosts, and concluded that this may be a factor in parasitism.

Al-Doory *et al.* (1959) correlated low fungul population in soil with its high soluble salt content.

Knowledge regarding physiology and ecology of soil pathogenic fungi is needed to understand many problems of their parasitic behavior.

The object of this study was to determine the effect of different concentrations of NaCl, Na<sub>2</sub>SO<sub>4</sub>, and MgCl<sub>2</sub> on growth of two pathogenic soil fungi, *Fusarium oxysporum* f. *lycopersici* Sacc. and *Rhizoctonia solani* Kuhn.

## MATERIALS AND METHODS

Isolates of *Fusarium oxysporum* f. *lycopersici* Sacc. and *Rhizoctonia solani* Kuhn, were obtained from *Fusarium*-wilt infected tomato, and tomato seedlings infected with damping off, respectively. The two fungi were grown on potato dextrose agar (Johanson 1959) and were used as source of inoculum during the study.

Different concentrations of NaCl, MgCl<sub>2</sub> and Na<sub>2</sub>SO<sub>4</sub> were made up by dissolving 1 to 10 grams of each into 100 cc PDA media before sterilizing. All salt concentrations are expressed in

terms of molality. Thirty cc of sterilized medium were poured into 11 cm petri dishes. Pieces of freshly prepared culture, cut by cork borer, were used for inoculation. Inoculation was carried out in a chamber to avoid contamination. All cultures were kept in an incubator at 21 C°.

Radial growth of the fungus colony was measured 2 days after inoculation as suggested by Brancato (1953). Randonized block design with 4 replicates was used in all experiments.

## RESULTS

### Effect of 0.171 to 0.855 Molal Na Cl

Effects of NaCl on growth of *F. oxysporum* and *R. solani* are shown in Table (1) and Figure (1). Growth of *F. oxysporum* was not

influenced greatly by NaCl. However, there was some reduction in growth with 0.684 and 0.855 molal NaCl.

**Table 1. Effect of various concentrations of Na Cl on growth of *F. oxysporum* and *R. solani***  
(Daily measurements of colony diameter in mm)

Fungus	Days after inoculation	Molality					
		Control	0.171	0.342	0.513	0.684	0.855
<i>F. oxysporum</i>	2	20.75	20.0	15.75	14.5	11.5	12.5
	3	31.25	30.0	23.5	20.33	19.75	19.5
	4	43.30	42.5	48.75	31.66	29.25	27.5
	5	53.33	55.5	49.5	44.66	39.0	42.25
	6	64.66	70.0	64.5	57.33	49.5	50.0
	7	75.0	83.8	74.75	70.0	59.5	60.0
	8	90.0	98.0	85.0	83.0	75.0	77.0
	9	110.0	110.0	96.0	95.0	90.0	90.0
	2	34.25	23.0	15.5	10.5	0.00	0.00
<i>R. solani</i>	3	67.75	43.33	35.75	21.5	0.00	0.00
	4	107.5	69.0	56.0	35.75	12.33	10.0
	5	110.0	90.0	73.0	49.5	25.0	14.0
	6	—	110.0	90.0	62.25	34.0	18.25
	7	—	—	110.0	72.0	42.0	20.0
	8	—	—	—	85.0	52.0	25.0
	9	—	—	—	99.25	60.0	29.5

Growth of *R. solani* was significantly affected by NaCl. Table (1) and Figure (1) illustrate correlation between radial growth of the colony and various levels of NaCl. When *R. solani* was cultured on 0.684 and 0.855 molal

NaCl medium, colony diameters were 25 and 14 mm, respectively, 5 days after inoculation, while radial growth on salt-free medium was 110 mm, during the same period.



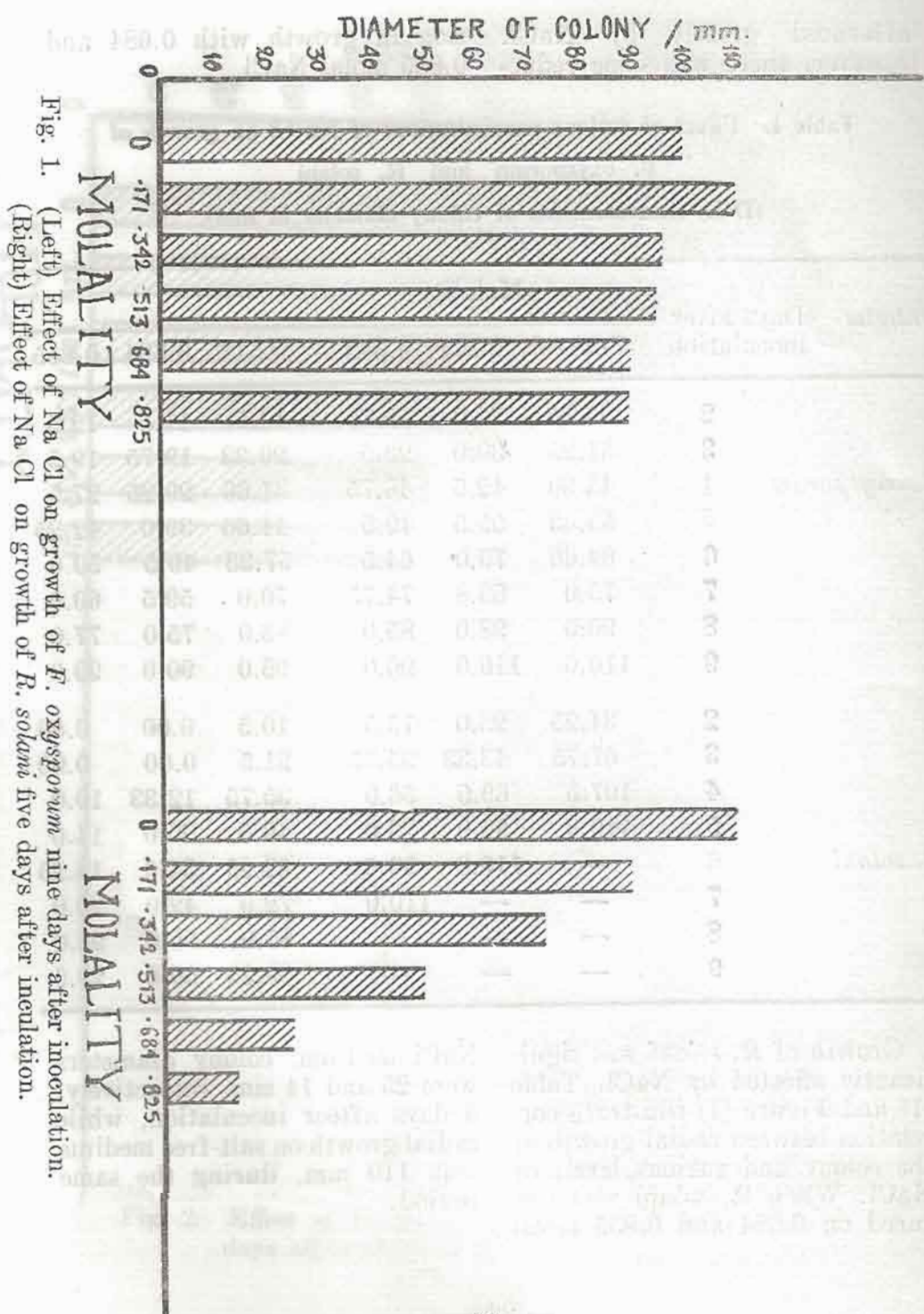


Fig. 1. (Left) Effect of Na Cl on growth of *F. oxysporum* nine days after inoculation.  
(Right) Effect of Na Cl on growth of *R. solani* five days after inoculation.

### Effect of 0.926 to 1.710 Molal Na Cl

Effect of higher NaCl concentrations on radial growth of *F. oxysporum* and *R. solani* is shown in Table (2) and Figure (2). *R. solani* did not grow on media containing more than 0.855 molal NaCl. Growth of *F. oxysporum* was reduced with increase in NaCl concentration. Diameter of *F. oxysporum* colony was 110

mm. on NaCl free medium 9 days after inoculation, while the colonies were 80, 66.5, 62.5, 51.5 and 46 mm. in diameter during the same period when the fungus was grown on 0.926, 1.097, 1.368, 1.539 and 1.710 molal NaCl, respectively. *F. oxysporum* was more tolerant to NaCl than, *R. solani*.

**Table 2. Effect of various concentrations of Na Cl on the growth of *F. oxysporum* and *R. solani***

(Daily measurements of colony diameter in mm)

Fungus	Days after inoculation	Molality					
		Control	.926	1.097	1.368	1.539	1.710
<i>F. oxysporum</i>	2	20.0	00.00	00.00	00.00	00.00	00.00
	3	30.5	20.0	16.0	14.25	13.0	11.5
	4	43.5	31.0	24.0	21.25	19.5	18.5
	5	57.5	41.5	33.5	30.5	26.0	24.5
	6	69.0	50.0	41.5	37.75	32.5	29.5
	7	83.0	59.5	50.0	46.0	39.5	35.5
	8	97.0	69.5	58.0	54.0	46.0	40.0
	9	110.0	80.0	66.5	62.5	51.5	46.0

*R. solani*

No growth was obtained

### Effect of 0.630 to 1.05 Molal Mg Cl<sub>2</sub>

Preliminary tests indicated no significant effects on radial growth of *F. oxysporum* and *R. solani* up to 0.525 molal MgCl<sub>2</sub>. By using higher concentrations of MgCl<sub>2</sub>, significant reductions in growth of both fungi were obtained

(Table 3 and Figure 3). Radial growth of *R. solani* was influenced more than that of *F. oxysporum* by MgCl<sub>2</sub>.

Ten days after inoculation, diameter of *R. solani* colony was 14 mm, when grown on a medium



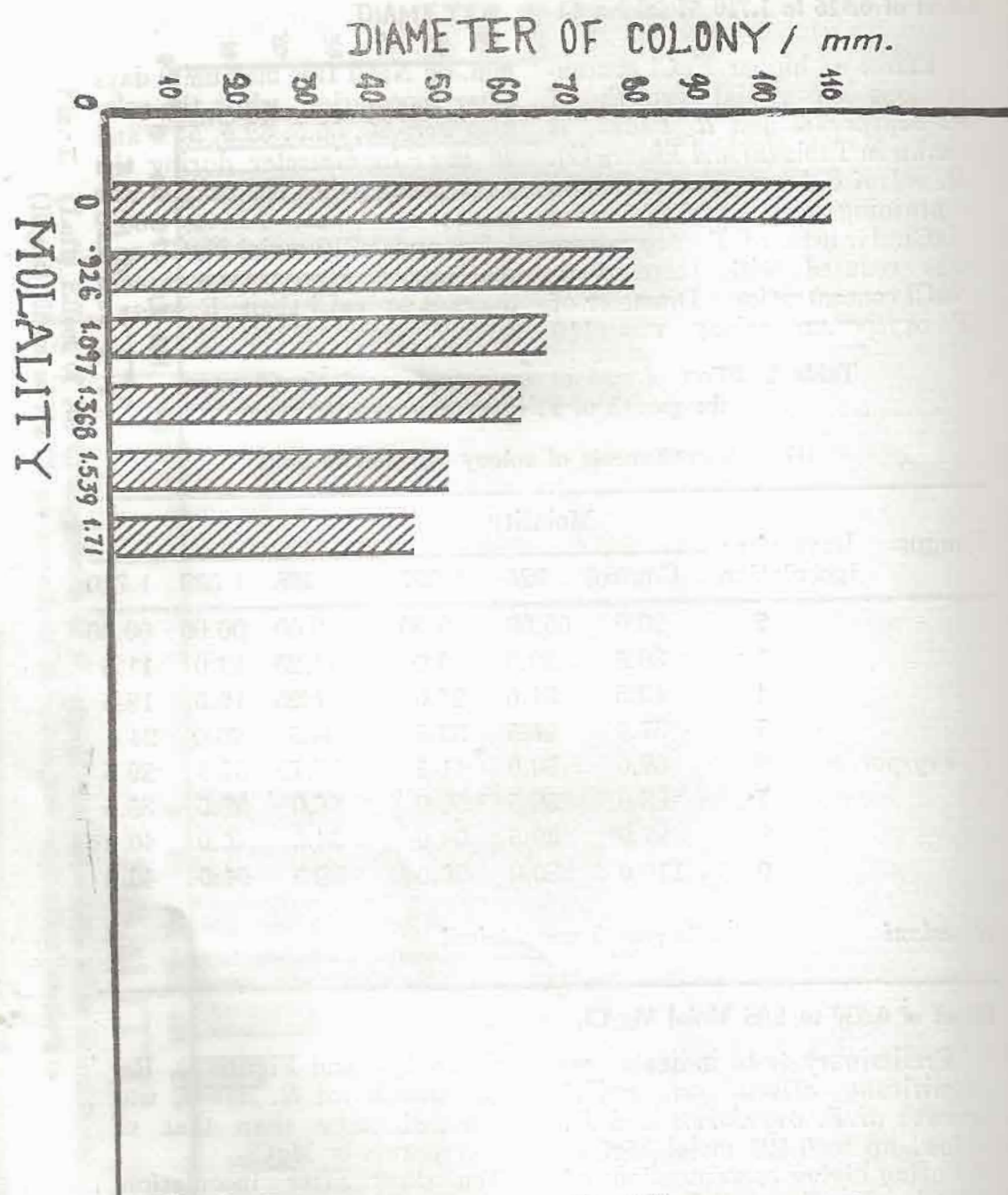


Fig. 2. Effect of Na Cl on growth of *F. oxysporum* nine days after inoculation.

containing 1.05 molal  $MgCl_2$  in a colony diameter of 68 mm. (which was the highest level), while the effect of the same concentration during the same period on *F. oxysporum* resulted

It was evident therefore, that *F. oxysporum* was more tolerant to  $MgCl_2$  than *R. solani* at similar concentrations.

**Table 3. Effect of various concentrations of  $MgCl_2$  on growth of *F. oxysporum* and *R. solani***  
(Daily measurements of colony diameter in mm)

	Days after inoculation	MOLALITY					
		Control	.630	.725	.840	.945	1.05
<i>F. oxysporum</i>	3	25.6	17.5	16.0	17.5	15.5	10.5
	4	38.0	24.25	23.25	24.5	22.25	17.25
	5	50.75	38.0	35.5	35.5	33.0	28.5
	6	61.75	41.25	41.0	44.0	39.0	31.0
	7	79.75	57.0	55.75	54.0	50.0	44.0
	8	101.0	78.0	76.25	75.5	71.0	59.0
	9	110.0	92.25	89.5	87.75	79.25	68.5
<i>R. solani</i>	3	37.75	12.72	8.25	0.00	0.00	0.00
	4	71.25	26.25	14.75	10.25	8.25	0.00
	5	110.0	39.75	23.0	14.25	10.0	8.25
	6		54.25	28.25	17.25	12.5	10.0
	7		67.75	33.50	20.0	15.0	11.0
	8		82.75	73.5	22.5	17.66	12.75
	9		110.0	64.25	29.25	21.0	14.0

#### Effect of 0.07 to 0.70 Molal $Na_2SO_4$

Only effect of various concentrations of  $Na_2SO_4$  on radial growth of *F. oxysporum* was determined. Results of this experiment are shown in Table (4) and Figure (4). Data indicated that significant reduction in fungus growth was associated with increase in  $Na_2SO_4$

concentration. Diameter of colony was 110 mm, 9 days after inoculation, when it was grown on  $Na_2SO_4$  free medium, while it was 28 mm on medium with 0.70 molal  $Na_2SO_4$  during the same period. By comparing the effect of  $NaCl$  (Table 2) with the effect of  $Na_2SO_4$ ,



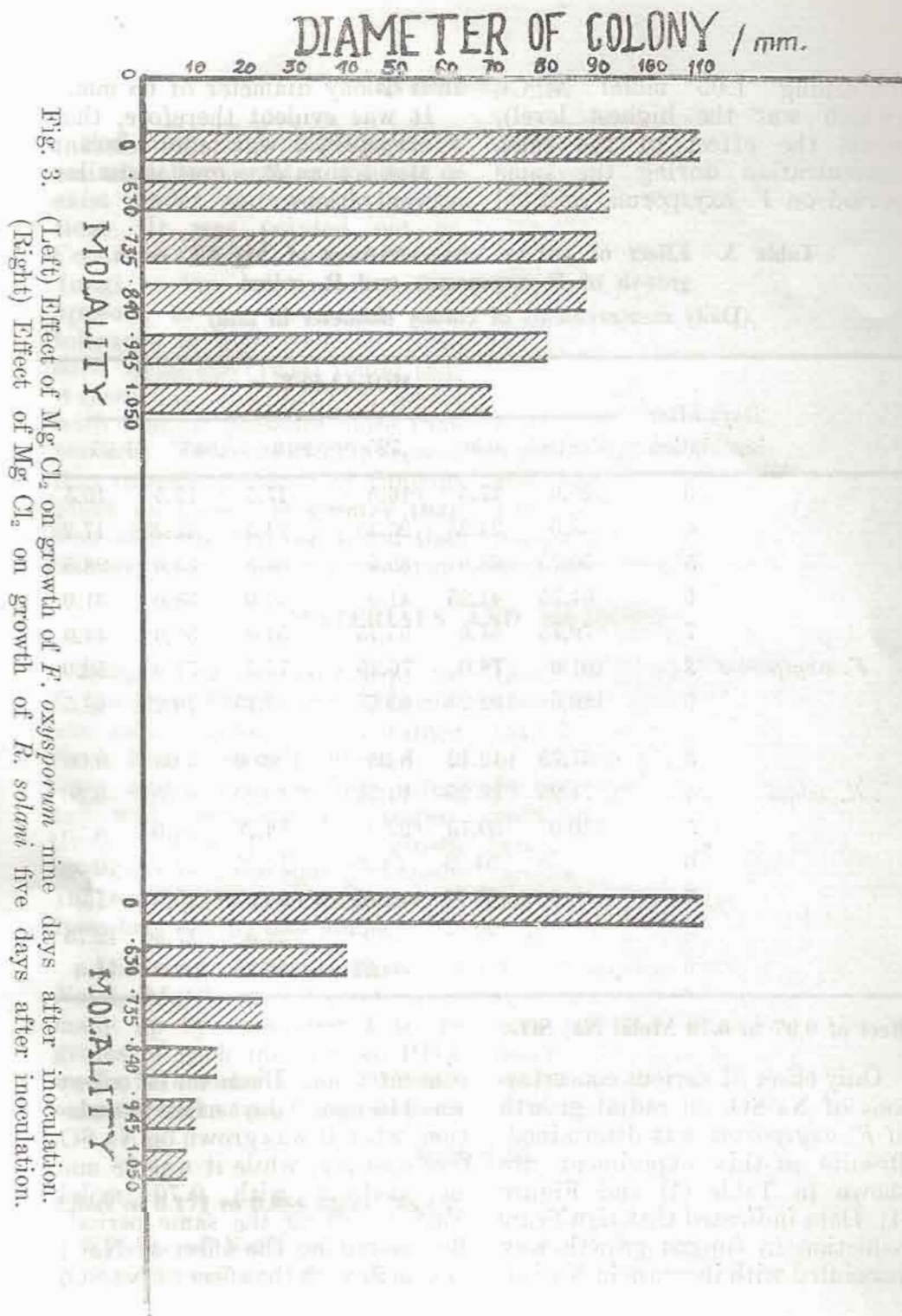


Fig. 3. (Left) Effect of  $MgCl_2$  on growth of *F. oxysporum* nine days after inoculation.  
(Right) Effect of  $MgCl_2$  on growth of *R. solani* five days after inoculation.

(Table 4) it can be seen that *oxysporum* than NaCl. Na<sub>2</sub>SO<sub>4</sub> was more inhibitive to *F.*

**Table 4. Effect of various concentrations of Na<sub>2</sub> SO<sub>4</sub> on growth of *F. oxysporum***  
(Daily measurements of colony diameter in mm)

days after inoculation	Molality										
	control	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56	0.63	0.70
2	19.50	19.25	18.25	12.5	9.75	0.00	0.00	0.00	0.00	0.00	0.00
3	30.0	35.0	30.0	19.0	15.0	13.0	12.0	0.00	0.00	0.00	0.00
4	40.0	49.0	40.0	23.0	20.0	18.0	15.0	9.0	8.0	8.0	0.0
5	61.0	68.0	55.0	32.0	27.0	25.0	20.0	16.0	15.0	14.0	12.0
6	78.0	82.0	72.0	40.0	32.0	31.0	25.0	23.0	21.0	21.0	20.0
7	91.0	95.0	85.0	50.0	40.0	38.0	30.0	29.0	26.0	25.0	22.0
8	101.0	104.0	98.0	58.0	46.0	42.0	36.0	35.0	31.0	30.0	25.0
9	110.0	110.0	110.0	65.0	52.0	49.0	40.0	40.0	35.0	35.0	28.0

### DISCUSSION

Results of these experiments, indicated that there was difference between the two pathogens with respect to their growth in the salty media used. *R. solani* was more sensitive to salts than *F. oxysporum*. These results agree with those reported by Brancato (1954). Various salts had different effects on growth of these fungi. Effect of MgCl<sub>2</sub> on growth of *R. solani* was less than that of NaCl at the same concentration. *R. solani* did not grow on a medium containing 1.09 molal NaCl, but it did grow on 1.05 molal MgCl<sub>2</sub>.

Radial growth of *F. oxysporum* was influenced by Na<sub>2</sub>SO<sub>4</sub> more than by NaCl and MgCl<sub>2</sub> at the same concentration. Colony diameters were 35, 92, and 90 mm. 9 days after inoculation, when *F. oxysporum* was cultured in media with 0.630 molal Na<sub>2</sub>SO<sub>4</sub>,

0.630 molal MgCl<sub>2</sub> and 0.680 molal NaCl, respectively. These results suggested a specific salt effect on fungus growth. Hawkis (1913) emphasized the fact that properties of salts and other substances should be investigated before a suitable explanation of the relation of osmotic concentrations to fungus growth can be made. Figure (5) shows the relation between osmotic pressure produced by various salt concentrations and radial growth of *F. oxysporum* and *R. solani*. Approximate values of osmotic pressure calculated from molal freezing - point depression (taken from the Handbook of Chemistry and Physics) showed that the osmotic pressure of 0.513 molal NaCl is about 21 atm., of 0.210 molal Na<sub>2</sub>SO<sub>4</sub> is about 10.4 atm., and of 0.315 molal MgCl<sub>2</sub> is about



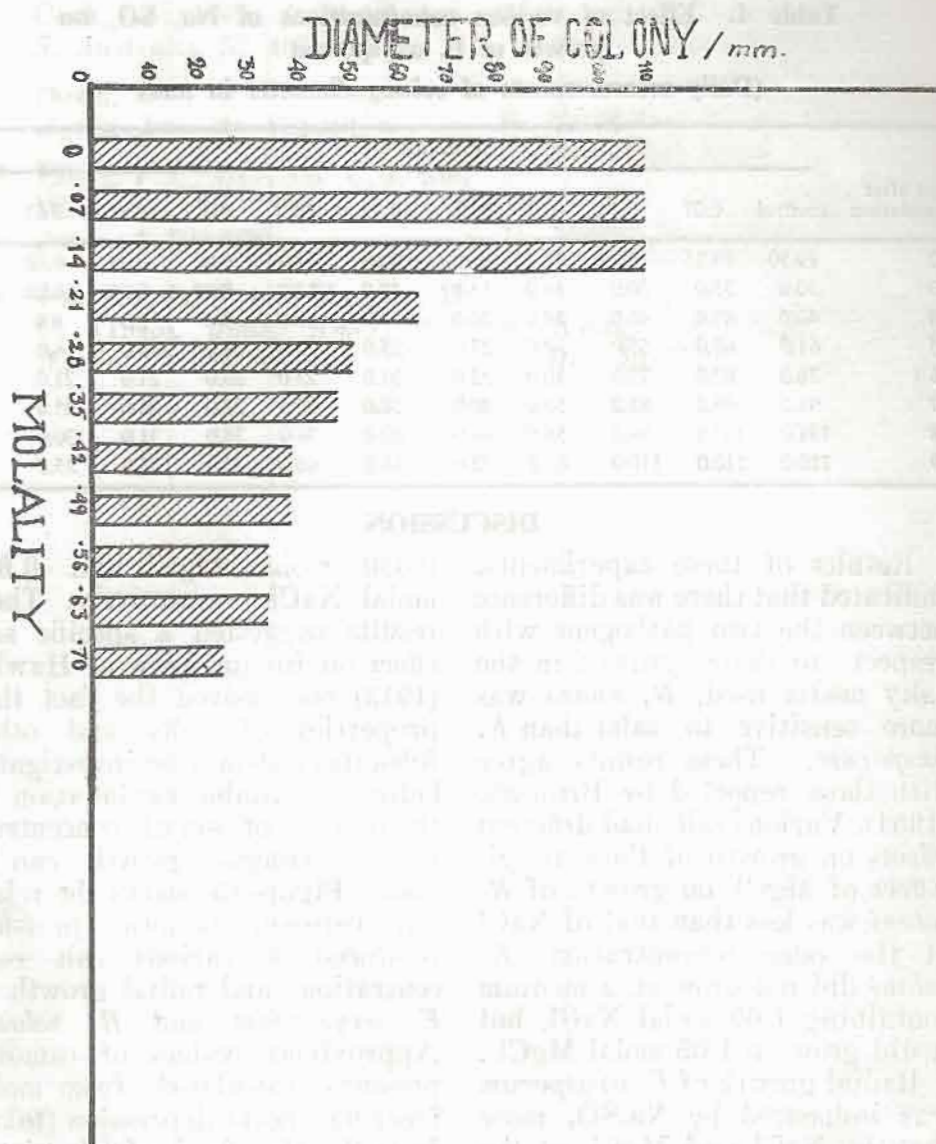


Fig. 4. Effect of  $\text{Na}_2\text{SO}_4$  on growth of *F. oxysporum* nine days after inoculation.

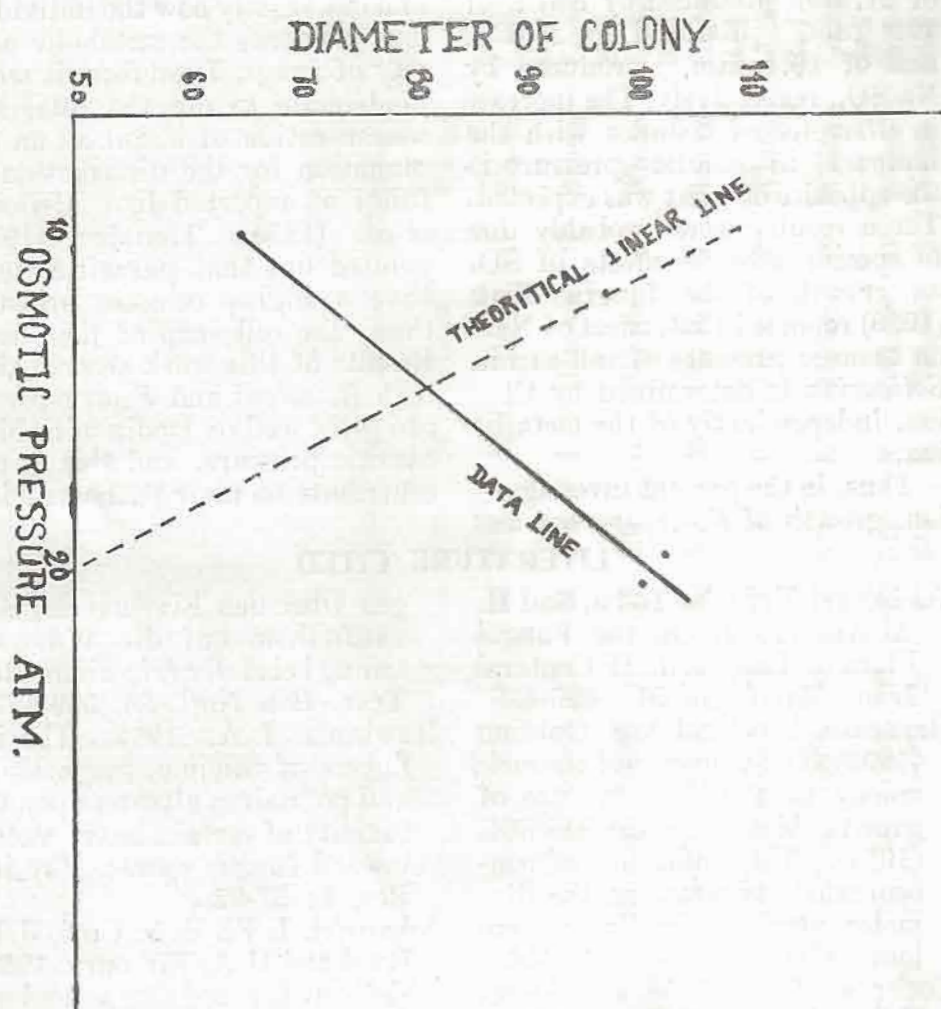


Fig. 5. Relation of growth of *F. oxysporum* to Osmotic Pressure of medium.



19.4 atm. Diameters of *F. oxysporum* colonies, 9 days after inoculation, were 101, 103, and 65 mm when it was cultured on media with an osmotic pressure of 21 atm. produced by NaCl, of 19.4 atm. produced by MgCl<sub>2</sub>, and of 10.4 atm. produced by Na<sub>2</sub>SO<sub>4</sub>, respectively. The increase in diameter of colonies with the increase in osmotic pressure is the opposite of what was expected. These results were probably due to specific adverse effects of SO<sub>4</sub> on growth of the fungi. Eijk (1939) reported that, effect of NaCl on osmotic pressure of cell sap in *Salicornia* is determined by Cl ion, independently of the metallic ion.

Thus, in the present investigation, growth of *F. oxysporum* was

influenced more by the low osmotic pressure medium of Na<sub>2</sub>SO<sub>4</sub> than by the high osmotic pressure medium of NaCl and MgCl<sub>2</sub>. Further work should be done to find out exactly how the individual ions influence the metabolic activity of fungi. Therefore, it seems inadequate to use the total salt concentration of a soil as an explanation for the distribution of fungi as reported by Al-Doory *et al.* (1959). Thatcher (1939) pointed out that parasitic fungi have a higher osmotic pressure than the cell sap of the host. Results of this work showed that both *R. solani* and *F. oxysporum* can grow well on media with high osmotic pressure, and this might contribute to their pathogenicity.

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## SOME FACTORS AFFECTING FLEECE WEIGHT OF AWASSI SHEEP IN IRAQ

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### SUMMARY

A statistical analysis was carried out on records collected on Awassi ewes maintained at Abu-Ghraib farm over the years 1959—1964. The aim of the work was to study wool production and environmental factors affecting this trait. Repeatability of fleece weight and body weight were investigated. Some 1450 shearings produced from 626 ewes were utilized and results obtained can be summarized and listed as follows :

- (1) Age, body weight and year in Awassi ewes were found to affect wool production. The maximum wool production was obtained from the second shearing (29 months) and from ewes whose body weights range between 126—135 pounds.
- (2) The repeatability estimates of fleece weight and body weight were found to be 0.02 and 0.43, respectively.

### الخلاصة

اجرى تحليل احصائيا على سجلات النعاج العراسية لعام ١٦٥٩ - ١٩٦٤ العائدة لقطيع مزرعة ابي غريب لغرض دراسة التاج الصوف وبعض العوامل البيئية التي تؤثر عليه وتقدير المعامل التكراري لكل من وزن الجزة ووزن الحيوان . يمكن تلخيص نتائج الدراسة التي شملت ١٤٥٠ جزة من ٦٢٦ نعجة كالآتي :

- (١) كان لكل من العمر والوزن والسنة اثر على كمية الصوف الناتجة . وأعطت الجزة الثانية، أى عندما يكون عمر النعاج ٢٩ شهرا ، والنعاج التي يتراوح وزنها بين ١٢٦ - ١٣٥ باونا أكبر كمية من الصوف .
- (٢) كان المعامل التكراري لوزن الجزة ووزن الحيوان ( ٠.٠٢ ) و ( ٠.٤٣ ) على التوالي .

### INTRODUCTION

Sheep breeds raised in Iraq belong to the fat-tailed, coarse-wool group. They are maintained primarily for mutton beside wool and milk production. Palestine and Algeria. The estimated sheep population in Iraq is around ten million head which includes nomadic and semi-nomadic flocks, two thirds of which are Awassi sheep.

Awassi sheep, as it was mentioned in the International Convention of Sheep Production in Rome in 1949, are found in Iraq, Syria, Turkey, The present work was carried out to study some environmental factors influencing weight of fleece in Awassi sheep. Factors studied were age, body



weight and year. The repeatability of wool production as well as of body weight were also estimated. Such information is needed when formulating breeding plans to improve wool production in the country.

## MATERIAL AND METHODS

Data used in this analysis were collected on the flock of Awassi ewes raised at Abu-Ghraib farm of the Ministry of Agriculture and which is situated some 20 miles from Baghdad. Number of males were very limited and therefore were not included in this report. The analysis utilized data collected over the years 1959—1964 and included 626 ewes having 1456 fleeces.

History of the flock as well as systems of feeding and management practiced were reported before (Asker, 1964). Animals are usually weighed after shearing once a year namely during April. Body weights are recorded to the nearest pound while weight of grease fleece is recorded to the nearest 0.25 pound. Statistical analyses were carried out in this report as described by Snedecor (1956).

## RESULTS AND DISCUSSION

### Effect of Age on Fleece Weight :

Fleece weight for ewes at different

shearings as well as the age of ewes are presented in Table (1).

Table (1) Weight of Fleece at Different Ages (lb)

Shearing Sequence	No.	Average Age (Month)	Average Weight of Fleece	C.V.%
I	626	16.9	3.02	22.52
II	397	28.9	3.41	21.41
III	235	40.8	3.37	19.88
IV	140	51.9	3.32	24.70
V	58	64.5	3.21	16.82
Total and Average	1,456		3.22	22.36

It can be seen from Table (1) that ewes are shorn for the first time when they are about 1.5 years old. The table also indicates that the minimum weight of fleece is obtained from the first shearing (17 months) and the maximum is obtained from the second

shearing. Values corresponding to third, fourth and fifth shearings are intermediate between that of the first and the second shearings.

The correlation coefficients between age of animals and their fleece weights are calculated within groups and

estimates are in most cases positive. However, the average correlation coefficient for the whole group came to 0.152 which is statistically significant.

In the improved Apulian breed the average weight of unwashed fleece reached a maximum at 3.5 years of age (third shearing) and thereafter declined (Maymone et al. 1956). Karam and Ragab (1959), on the other hand, found that the average fleece weight of the third shearing in Texel sheep exceeded that of the second in both males and females.

Weight of fleece of Awassi ewes studied ranged between 1.5 — 8.0 pounds with an average of 3.22 pounds while the corresponding figures for Awassi sheep raised in Turkey are 1.3 — 5.8 pounds with an average of 2.97 pounds (Sönmez, 1955). The

previously mentioned figures indicate the superiority of the Iraqi Awassi sheep in respect to wool production. Ossimi sheep in Egypt, however, produce an average of 1.9 pounds of grease fleece when 17 months old (Ragab et al. 1956).

#### Effect of Body Weight on Fleece Weight:

Body weight and corresponding fleece weight at various shearing sequences are given in Table (2). The table indicates that body weight increases after the first shearing (16.9 months) till attains the peak at the fourth shearing (52 months). These findings are in accordance with results obtained for commercial Awassi flocks in Iraq by Asker and El-Khalisi (1964). Nothacher (1952) also found that body weight increases rapidly during the first 3 years and followed by gradual decline.

Table (2) Body Weight and Corresponding Fleece Weight at Different Shearing Sequences (lb)

Shearing Sequence	No.	Average Fleece Weight	Average Body Weight	C.V.%
I	581	3.04	88.40	10.80
II	376	3.41	99.09	12.35
III	212	3.33	104.88	10.35
IV	124	3.35	105.52	14.91
V	61	3.23	100.95	12.49
Total and Average	1,354	3.22	96.08	13.88

The relationship between body weight of ewes and weight of fleece was found to be highly significant ( $r=0.198$ ). Maymone et al (1956) reported that the correlation between fleece weight and body weight in



improved Apulian breed to be 0.21. In Hungarian Combing Wool Merinos the coefficient was found, in 245 ewes aged 2.5 years, to be 0.47 (Horn and Sabestyen 1956). Morley (1955) and Morley et al (1955) when working on a strain of Australian Merino sheep found a significant correlation between body weight and total raw wool production. Although body weight and wool production per unit of body surface is independent (Schinkel, 1956) yet the correlation was found to be non-significant (Morley et al 1955). On the other hand, Hutchinson (1961) reported a non-significant relationship between wool production and body weight. It was reported, however, that body weight is an adequate expression of body surface for wool production (McFadden and Neale.

1954). Weston (1959) stated that wool production per unit of body weight may be a useful criterion for selecting efficient wool producing sheep at pasture.

When ewes were grouped according to their body weights into 8 groups with class intervals of 20 pounds (Table 3), the maximum weight of fleece was obtained from ewes weighing on the average 126-135 pounds. The difference among the groups in fleece weight was found to be statistically highly significant (Table 4). In Hungarian Combing Wool Merino sheep it was found that the most economic body weight for wool production to be 88-110 pounds which produced on the average 10.5 pounds of wool (Czuppon, 1956).

**Table (3) Fleece Weight (lb.) of Ewes of Different Body Weights (lb.)**

Body Weight	75 and Below	76-85	86-95	96- 105	106- 115	116- 125	126- 135	136- 155
Fleece Weight	2.91	3.02	3.16	3.30	3.45	3.62	3.68	3.45
% Fleece Wt. to the highest	79.08	82.06	85.87	89.67	93.75	98.37	100.0	93.75

**Table (4) Analysis of Variance of Fleece Weight of Groups of Ewes of Different Body Weights.**

Source of Variation	D.F.	Mean Square	F
Total	1,287	—	—
Among Groups	7	6.27	12.06
Within Individuals	1,280	0.52	—

The average body weight for the Awassi ewes was found to be 96.08 pounds which indicates that Awassi ewes in Iraq are superior to Awassi ewes in Turkey in this aspect since Sönmez (1955) reported that the average body weight of Awassi ewes in Turkey is 84.04 pounds.

#### Effect of Year on Wool Production :

Annual wool production of ewes was studied and results obtained are given in Table (5). Annual average weight of fleece, in general, exhibits an increase over the past few years. Estimate, however, are fluctuating from year to year which is probably due to various environmental factors.

Table (5) Annual Fleece Production (lb)

Shearing Season	No.	Mean	C.V.%
1959/60	53	2.39	30.88
1960/61	137	3.15	24.76
1961/62	207	2.98	31.91
1962/63	343	3.63	22.53
1963/64	570	3.07	12.83

#### Repeatability of Economics

##### Characters :

It is well established that repeatability and heritability of economic characters in livestock are two important genetic parameters used to enforce accurate selection. In this paper repeatability of fleece weight and body weight were estimated. It was not possible, however, to study the heritability of these characters because the lacking of information.

Repeatability of fleece weight from 1217 observations was found to be 0.02 which is lower than estimates reported by many workers. Lush and Jones (1923), Terril (1939), Rasmussen (1941) and Hutchinson (1961) estimated the repeatability of annual fleece weight for different breeds of sheep in

different countries. Their estimates range from 0.43 to 0.79. Maymone (1956) reported a repeatability estimate of 0.61 for fleece weight in improved Apulian sheep. Young et al (1960), however, estimated the repeatability of greasy wool weight in unselected and mass-selected Merino ewes as 0.637 and 0.600, respectively.

In this analysis, using 1048 observations, the repeatability of body weight was found to be 0.43. This estimate is also lower than estimates reported by Young et al (1960) which amounted to 0.669 and 0.733 in unselected and mass-selected Merino ewes respectively.

Improvement of fleece weight and body weight will, therefore, necessitate, 1) full use of all available informa-



tion on pedigree, 2) the application of a new system of mating by which sires will be identified, 3) selection for heavy body weight and 4) progeny testing. The low repeatability of fleece weight obtained here indicates that the heritability for fleece weight

is very low. This low heritability of fleece weight, however, demonstrates the big role of environmental factors affecting it. Therefore, raising and improving the feeding and management practices will lead to an improvement in economic traits of sheep.

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## WEED SEEDS IN MARKETING WHEAT AND BARLEY IN IRAQ

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### SUMMARY

Samples from each of fifty shipments of wheat and barely produced in various sections of Iraq were studied for purity and content of weed seeds. The results revealed that about one-third of the wheat lots contained less than 90% pure crop. The barley data revealed that there was varietal mixing in the seed stock.

Crops grown on irrigated lands contained much more weed seeds than those grown on non-irrigated lands. Rigid rye grass, darnel and wild oats were the most common and most abundant weed seeds in both crops. *Cephalaria* and wild mustard were mostly found in crops grown in the Northern region, while leguminous weeds were more common in the Central and Southern regions.

### الخلاصة

يهدف هذا البحث الى تقييم حالة الحنطة والشعير في العراق من ناحيتي النقاوة وانتشار بذور الادغال وتحديد أنواعها . ولتحقيق ذلك تم اختيار خمسين عينة من الحنطة والشعير تمثل مختلف مناطق انتاج الحبوب في العراق وذلك بأخذها من خمسين شحنة مختلفة .  
ودلت نتائج اختبارات الحنطة على أن ثلث العينات كانت تحتوي على نسبة أقل من ٩٠ ٪ حبوب نقية ، بينما دل فحص عينات الشعير على أنها خليط من الاصناف .  
كما وضح ان عينات الحبوب التي أخذت من المناطق الاروائية تحتوي على بذور ادغال تزيد بكثير عن عينات الحبوب الناتجة من الاراضي الدائمة .  
وبفحص الحبوب وجد فيها ٢٣ نوعا من بذور الادغال وكان اكثرها انتشارا من ناحيتي تكرار وجودها وكميتها بذور الحنطة والرويطه والشوفان البري .  
وبمقارنة حبوب معاصيل المناطق المختلفة وجد أن حبوب شمال العراق تحتوي على زيوان وخردل برى بينما حبوب المنطقتين الوسطى والجنوبية تحتوي على بذور ادغال بقولية بكثرة .

### INTRODUCTION

The presence of weed seeds in marketed grains reduce the cash value of the crop considerably. A shipment of grains may be rejected in the market because of infestation with seeds of certain weeds. Robbins et al. (1952) reported that seeds of wild mustard (*Brassica arvensis*) for example, when ground with wheat give the flour an unpleasant odor and taste. They also stated that "even a few seeds of annual yellow sweet clover (*Melilotus indicus*) will render a sack of wheat unfit for mill". Edgecombe (1959) mentioned that seeds of darnel (*Lolium temulentum*) when milled with wheat give the flour a gray color and bitter taste. Seeds of this weed are poisonous to man and some kind of the animals.

Hassawy and Tamimi (1965) identified 36 species of weeds in wheat fields of Baghdad area and determined the types and quantities of weed seeds in one shipment of wheat. Outside of this report, and as far as known, no major work has been done in Iraq to study weed seeds in wheat and barley. It is believed that such work can be of considerable value to those people who are in charge of handling grains on

national or international levels. Such work may also lead to elimination of more harmful weed species in fields by simple agricultural practices.

The objectives of this work were: (a) to conduct purity tests on wheat and barley produced in the various small-grain regions of Iraq, and (b) to determine the types and quantities of weed seeds in the two crops.

#### MATERIALS AND METHODS

Bulk samples were obtained from 50 shipments of wheat and barley which were imported into Baghdad grain markets and "silos" from Northern, Central and Southern regions of Iraq. Probes were used when ever it was possible to derive these bulk

samples. The weight of the sample varied according to the size of the shipment and the range was from 1-5 kgms. per sample. Some of the important informations on these grain shipments are presented in Table 1.

**Table 1. Crop, number of shipments tested and region of production for five groups of wheat and barley which were studied for purity and content of weed seeds.**

Group	Crop	Number of shipments tested	Region of production	Irrigated or non-irrigated fields
A	Common wheat ( <i>Triticum vulgare</i> )	18	Northern	Non-irrigated
B	Common wheat ( <i>T. vulgare</i> )	11	Southern and Central	Irrigated
C	Durum wheat ( <i>T. durum</i> )	2	Northern	Non-irrigated
D	Barley ( <i>Hordeum vulgare</i> )	7	Northern	Non-irrigated
E	Barley ( <i>H. vulgare</i> )	12	Southern and Central	Irrigated



The bulk samples were brought into the Grain Grading Laboratory of the College of Agriculture for analysis. Each bulk sample was thoroughly mixed and one sub-sample of about 300 grams was taken at random for careful analysis. Each sub-sample was separated into the following four components: (a) pure grains of the crop; (b) grains of other crops (black barley grains in a white barley sample were placed in this category and vice versa); (c) inert

materials, which included broken grains and all dead matter; and (d) weed seeds. These four components were weighed carefully for each sub-sample and were recorded as percentages.

Weed seeds from each sub-sample were separated into species and identified. Weights per weed species per sub-sample were recorded as percentage of the original weight for weed seeds in the sub-sample.

## RESULTS

Results of purity tests conducted on five groups of wheat and barley are given in Table 2.

Table 2. Results of purity-tests conducted on five groups of wheat and barley which were described in Table 1.

Group	% pure crops			% other crops			% inert matter			% weed-seeds		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
A	97.73	84.30	92.00	4.73	0.40	1.71	9.57	1.27	4.49	3.65	0.15	1.18
B	96.37	75.60	87.07	20.70	0.87	6.59	5.17	0.93	2.33	10.62	0.12	2.16
C	91.90	89.37	90.64	0.40	0.10	0.25	5.33	4.17	4.75	2.64	2.51	2.58
D	93.63	67.73	77.95	23.87	0.01	13.40	9.67	4.01	6.85	4.12	0.11	1.36
E	91.40	75.11	83.76	10.87	1.82	5.49	8.07	1.57	3.73	18.94	0.65	5.42

A comparison between wheat and barley for content of pure crop in this table showed that wheat was superior in purity. With regard to inert matter variations among the five groups of grains were comparatively small. The most remarkable difference which these analyses revealed was in content of weed seeds between grains grown on irrigated fields

and those grown on non-irrigated fields. In general, grains produced under irrigation contained 2-3 times as much weed seeds as those produced in non-irrigated areas.

Seeds of 23 species of weeds were found in all samples tested. Names of these species and number of shipments in which each

species was found are given in Table 3. From this table it was

**Table 3.** Species of weeds which infested wheat and barley produced in various regions of Iraq with their seeds. Weed seeds were isolated from about 300 gram-samples which were derived from each of 50 shipments of marketed grains in Baghdad markets, of which 23 shipments were from irrigated and 27 from non-irrigated fields.

Scientific Name	Common Name	Number of shipment containing seeds of the weed species from:	
		Irrigated	Non-irrigated
1. <i>Aegilops crassa</i> Boiss.	Goat grass	2	14
2. <i>Avena fatua</i> L.	Wild oats	22	10
3. <i>Beta vulgaris</i> L.	Wild beets	4	0
4. <i>Brassica arvensis</i> Ktze.	Wild mustard	1	15
5. <i>Carthamus oxyacanthus</i> M.B.	Wild safflower	0	14
6. <i>Cephalaria syriaca</i> (L.) Schrad.	Syrian cephalaria	3	24
7. <i>Convolvulus arvensis</i> L.	Field bindweed	2	3
8. <i>Galium ceratopodium</i> Boiss.	Bedstraw	0	4
9. <i>Glycyrrhiza glabra</i> L.	Common liquorice	0	2
10. <i>Gundelia tournefortii</i> L.	Gundelia	0	5
11. <i>Lathyrus annuus</i> L.	Two-flowered vetchling	10	2
12. <i>Lepidium draba</i> L.	Hoary cress	3	0
13. <i>Lolium rigidum</i> Gaud.	Rigid rye grass	23	27
14. <i>Lolium temulentum</i> L.	Darnel	23	27
15. <i>Malva rotundifolia</i> L.	Small leaved mallow	2	1
16. <i>Medicago hispida</i> Gaert.	Toothed medic	5	0
17. <i>Melilotus indicus</i> (L.) All.	Yellow sweet clover	9	0
18. <i>Phalaris minor</i> Retz.	Mediterranean canary grass	5	4
19. <i>Scorpiurus sulcata</i> L.	Furrowed caterpillar	1	0
20. <i>Sorghum halipense</i> (L.) Pers.	Johnson grass	2	0
21. <i>Trifolium procumbens</i> L.	Hop clover	3	0
22. <i>Verbascum laetum</i> Boiss. et Haussk.	Mullein	0	1
23. <i>Vicia calcarata</i> Desf.	Narrow-leaved vetch	5	2



clear that rigid rye grass (*Lolium rigidum*) and darnel (*Lolium temulentum*) were present in all shipments tested. Wild oats (*Avena fatua*) was found in 22 of the 23 shipments grown on irrigated lands and in 10 of the 27 shipments produced on non-irrigated fields. Syrian cephalaria (*Cephalaria syriaca*), wild mustard (*Brassica arvensis*), wild safflower (*Carthamus oxyacanthus*) and goat grass (*Aegilops crassa*) were much more abundant in non-irrigated small grain fields than in irrigated. On the other hand, leguminous weed

species like yellow sweet clover (*Melilotus indicus*), two-flowered vetchling (*Lathyrus annuus*) and toothed medic (*Medicago hispida*) were found more frequently in grains produced on irrigated fields. Seeds of other weed species were found in fewer shipments and in one or both areas of production.

One sample of wheat from irrigated fields contained 0.37% nematode galls. The galls were crushed and examined under the microscope and were found to contain larvae of *Anguinea tritici*.

### DISCUSSION

The number of shipments per group of grains tested in this study varied according to the importance of the crop and to the region of production. Common wheat, for example, is more important than barley and by far more important than durum wheat; thus more common wheat samples were included in this investigation. Also, more than two-thirds of the common wheat produced in Iraq is grown in the non-irrigated Northern region; accordingly, 18 of the 29 common wheat lots were selected from this region.

The weight per working sample for wheat and barley was set at 100 gr. for purity test and at larger weights for testing content of noxious weed seeds (Morsi, 1958; Musil, 1961). Since the

objectives of this work were testing for purity and content of weed seeds in general rather than noxious weeds, 300 grs. were thought to be sufficient for both objectives.

The barley produced in Northern region of Iraq belongs to the black barley class, while that produced in the irrigated Central and Southern regions is white barley. In all barley samples tested there was some mixing of the two classes. To determine the amount of varietal mixing in this study, white barley grains in a black barley sample and vice versa were placed in the category of grains of other crops. Such a step was not possible with wheat; but from the barley data, one may conclude that the seedstock used by the Iraqi farmer



lacks vertical purity. Similar evidence was obtained with local rice varieties in Iraq (Tamimi, 1964).

Many countries of the world have established rules and regulations for marketing grains on national and international levels. In the United Arab Republic, for example, a wheat lot marketed to be sold as a seed-stock is rejected from the market if it contains less than 90% pure crop or if it contains more than 1.4% weed seeds (Morsi, 1958). According to this rule, 12 of the 29 wheat shipments would be rejected on basis of purity and 11 on basis of weed seeds content. Ten of 12 barley shipments from irrigated regions also would be rejected on basis of weed seeds content. These observations suggest that methods of production and handling of grains should be improved in order to provide cleaner seed stock to the farmers in Iraq.

Of the 23 species of the weeds which infested the crops with their seeds, six species were narrow leaved or grassy type weeds. This means that 17 species (broad leaved) can be controlled effectively with some selective herbicides like 2, 4-D. Tamimi

and Hassawy (1965) reported good control of broad leaved weeds in wheat plots by spraying 2, 4-D at a rate of 75-150 grams of acid equivalent per donum in two seasons at the College of Agriculture Farm in Abu Ghraib. Narrow leaved weeds on the other hand, can be controlled through crop rotations, clean cultivation and use of clean seed stock, since they are resistant to 2, 4-D.

Wheat containing seeds of wild mustard, cephalaria, annual yellow sweet clover or darnel even in small quantities may become unfit for industrial use, because seeds of these weeds impart objectionable odors and flavors to the flour (Robbins *et al.* 1952); Edgecombe, (1959). Seeds of the former two weed species were found in most of the shipments produced in the Northern region, while darnel seeds were found and in big quantities practically in every grain lot tested in this investigation. Annual yellow sweet clover seeds were found in grains produced on irrigated lands. Because of their adverse effect, these four weeds should be controlled with all possible means, not only in grain fields but in pastures and along irrigation ditches to prevent their invasion of cropped lands.

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## REHYDRATION AND SULFURING OF DATES\*

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### SUMMARY

Dry cheap Zahdi date was successfully rehydrated and sulfured to give a fresh Rutab-like product. The treated dates were lighter in color and were of good eating qualities. Their sulfur content was much lower than the legally accepted levels in other countries, and should present no harmful effect to consumers. Redrying of sulfured dates gave a dry product that had a stable light color during storage at room temperature, and better keeping qualities against insect infestation.

### الخلاصة

لقد تم إيجاد طريقة سهلة لتحويل التمر الزهدي الجاف (كسب) الرخيص الثمن إلى رطب (قضيح) باستعمال عمليتي النقع بالماء ثم التبخير بغاز ثاني اوكسيد الكبريت (الكبريت) • ويمتاز الرطب الناتج بلونه الفاتح وصفاته الجيدة المرغوبة ، علاوة على احتوائه على كميات قليلة من غاز ثاني اوكسيد الكبريت ، أقل من الكميات المصرح باستعمالها لحفظ بعض الاغذية في البلدان الاخرى مما يجعله عديم الضرر بالصحة العامة • وان إعادة تجفيف التمر الناتج مرة أخرى بعد عمليتي النقع والكبريت أدى الى إنتاج تمر جاف لها القابلية على الاحتفاظ بلونها الفاتح وقلة الاصابة بالحشرات عند الخزن في درجات حرارة الغرف العادية •

### INTRODUCTION

Most of the fresh fruits and some of the vegetables intended for drying or dehydration are exposed to sulfur dioxide just before going into drying yards or dehydrators (Mrak and Phaff, 1959; Phaff, 1951; von Loesecke, 1955; Cruess, 1958).

Sulfur dioxide, either in the form of a gas, or a soluble sulfite solution, aids in preserving the natural color and taste of the dried products (von Loesecke, 1949). Presence of sulfur dioxide

at concentrations of up to 2000-3000 ppm will retain the natural color of the product, discourage growth of insects, molds and bacteria and minimize the loss of ascorbic acid during storage (Blanck, 1955). But below 500 ppm the fruits will turn brown and stale (Blanck, 1955; von Loesecke, 1955). Some of the dried products that are usually treated with this compound are apricots, peaches, apples, pears, grapes, potatoes, cabbage and

(\*) This method was patented under Patent No. 429, January 24, 1965.



many others (U.S.D.A., 1950-1951; von Loesecke, 1955).

The sulfuring process has been used not only for treatment of dried products, but for other industrial purposes as well. This gas has been used in starch manufacture and in the wine industry to prevent growth of undesirable microorganisms that may cause spoilage of starch slurries or grape juice during alcoholic fermentation (Brautlecht, 1953; Desrosier, 1963). Wine may contain sulfur dioxide in concentrations ranging from 0-500 ppm (Amerine and Cruess, 1960).

Many fresh fruits are packed in sulfite solution for later use in preparation of jams, jellies and preserves (Aylward, 1955). It has been a practice to pack apple slices in sulfite solutions containing 2000-3000 ppm of sulfur dioxide for few weeks (Blanck, 1955).

The United States Government Laws permit the use of up to 200 ppm of this compound in the dried fruits (Desrosier, 1963), while in the United Kingdom higher concentrations (3000 ppm) have been allowed for better protection of their imported dried fruits (Aylward, 1955).

Most of the date produced in the world is consumed in the dried state due to its low moisture content and better keeping qualities. It is, however, difficult to keep freshly picked moist date (Rutab=Fudhikh) outside the refrigerator for more than few days. In the U.S.A. the dry dates are sold either pressed and packed in small packages, or rehydrated to a moderate moisture content (about 20%) and then treated with a fumigant and sold in cellophane or small cartons.

The Iraqi people pay higher prices for freshly picked Rutab and usually consume a large amount of such a product in season, August-September. After September the dates over-ripe and dry to a moisture content lower than 20%. The color of such dates turns darker during ripening on the trees, and darkens further during storage. Dry Zahdi date is either exported to foreign countries or stored for local consumption during winter time. It is consumed mainly by the low-income group or used for making date syrup (Dibis).

This study was undertaken to find out some new uses for the cheap Zahdi date and to increase its consumption among the Iraqi people.

#### MATERIALS AND METHODS

1. Dry Zahdi date of 1964 season was obtained from an orchard at the College of Agriculture, Abu Ghraib.
2. Each batch of chosen date was divided into six lots that were treated as follows:

- a. One lot was left as a control.
- b. One was washed with tap water only.
- c. Four lots were washed and then soaked in tap water.

These were numbered from 3-6, and were soaked for 12, 24, 36, and 48 hours respectively. They were soaked in such a way that all of the samples would come out of the soaking water at the same time, as shown in Table 1.

Table I Soaking Schedule of dry Zahdi date

Sample No.	Type of treatment	Soaking Time in	in tap water*	Soaking time (hours)
1	Control	—	—	0
2	Washed only	—	—	0
3	" & soaked	9:00P.M.	Sund. 9:00A.M.	Mond. 12
4	" "	9:00A.M.	" "	" 24
5	" "	9:00P.M.	Sat. "	" 36
6	" "	9:00A.M.	" "	" 48

3. All of the date lots were observed after rehydration and then were exposed to fumes of burning sulfur in the manner described below.

Dates were spread over wooden trays, 70 cm. long × 50 cm. wide. The bottoms of the trays were made of wooden strips, 1 cm. wide × 0.5 cm. thick. The strips were separated from each other by 0.5 cm. slits to allow sulfur dioxide to pass between the sulfured dates.

The trays were stacked over each other inside a wooden box, 150 cm. long × 96 cm. wide × 144 cm. high. About 350g. of sulfur flour were put in a deep can, 10 cm. in diameter and 15 cm. in depth, located under the trays. A burning match was set into the sulfur, and the box was closed tight, except for two holes, 3 cm. in diameter each. One hole was left at the bottom near the ground to allow entrance of fresh air

\* Temperature of soaking water was held at about 20°C during winter and at about 30°C during spring time.



for burning the sulfur and the other was at the top, opposite the other side, to allow removal of expanded air and excess sulfur dioxide. The dates were exposed to sulfur fumes for about five hours.

4. The dates were exposed, after sulfuring, to the air for about six hours to get rid of any excess free sulfur dioxide.

5. Samples were taken before and after the aeration process.

These samples were minced in a meat grinder and the paste was used for mois-

ture and sulfur dioxide determinations. Moisture was determined by drying 5-10 g. samples at 70°C in a vacuum oven (pressure not exceeding 50 mm.) for ten hours. Sulfur dioxide was determined according to the procedure given on page 639, Food Industries Manual (Adam, *et al.*, 1958).

6. Some of the rehydrated and sulfured dates were redried again to a moisture level of about 15-18% at 60°C in a regular laboratory oven for about 8-10 hours. These redried samples were stored at room temperature for further observations.

## RESULTS AND DISCUSSION

The moisture and sulfur dioxide contents of all of the date lots are presented in Table II.

Table II

Summary of moisture and sulfur dioxide contents and evaluation  
of quality of rehydrated and rehydrated and sulfured dates

Sample No.	Type of treatment	Soaking time in hours at 20°C.	Moisture %	Quality evaluation after rehydration	Sulfur dioxide ppm*	Quality evaluation of final product
1	Control — Sul-fured	0	11.5	Dry, having a dark brown color	145	Dry, having a dark brown color
2	Washed — ,	0	12.2	" "	150	Dry, having a dark brown color
3	Soaked — ,	12	19.3	Semi-dry, "	" 425	Semi-dry, " a light " "
4	" — ,	24	24.1	Semi-soft, "	" 560	Semi-soft, having a dark color
5	" — ,	36	28.5	Soft, having "	" 720	Soft, having golden-yellowish color, and a fresh date appearance.
6	" — ,	48	32.6	" "	" 770	Same as in sample 5 above with 15% cracking of dates after sulfuring.



The data presented above indicate that rehydration of dates in water for over 24 hours, samples 5 and 6, gave products similar in texture to that of fresh dates except that the color was still dark brown, similar to that of dry dates. Rehydration followed by sulfuring gave a product that was similar to freshly picked Rutab date as far as color, texture and eating qualities are concerned. This may be due to the bleaching action of sulfur dioxide

The best moisture level that gave the most desired results was found to be about 28%. Higher moisture content (for example 32.6% in sample 6), caused cracking of about 15% of the rehydrated dates during the sulfuring process, while low moisture content (as 24% for example) did not give the desired soft texture. It appears, therefore, that the most beneficial bleaching action of sulfur dioxide depends critically on the moisture content of the sample. The suitable moisture level mentioned above (28%) was reached in about 36 hours at 20°C, but this same moisture level was reached in a shorter period of time, about 24 hours at 30°C. This indicates the possibility of shortening the soaking time by increasing the temperature or by putting the dates in a heated chamber of high humidity. This problem needs further investigation.

Sulfur dioxide determinations in rehydrated and sulfured dates

showed that the concentration of this compound also was dependent mainly on the moisture level of the dates. The highest concentration ranged from 720-770 ppm in samples having 28.5-32.6% moisture. These concentrations were found directly after the sulfuring process and dropped to about 500-550 ppm a few hours later. Such concentrations are much lower than those permitted to be used in other products.

The quality and general look of dates produced were dependent upon the quality of the original dry date used. The date to be used should be clean and free from insects, blemishes and easily removable large loose skins. The presence of such skins were found to spoil the look of the prepared products due to their stripping during rehydration and sulfuring. Our general observations showed that the rehydrated and sulfured date could be kept in its fresh-looking qualities for about ten days at room temperature (about 20°C during winter season). The above mentioned findings indicate a simple method for changing the cheap dry Zahdi date into a more expensive product, Rutab, that can be retailed in the market for a good profit.

The samples, redried after rehydration and sulfuring, kept their light color and were free from insect infestation even after four months of storage at room

temperature. This may lead to the commercial possibilities of sulfurizing, even fresh dates, before drying and storage to minimize color browning and insect spoilage. This can be studied further.

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# LABORATORY AND FIELD STUDY ON THE TOXICITY OF CERTAIN INSECTICIDES TO THE CUCUMBER BEETLE IN ABU GHRAIB

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## SUMMARY

The toxicities of 12 insecticides to the cucumber beetle, *Aulacophora foveicollis* Lucas, were determined by topical application. The results showed that mevinphos, carbaryl and parathion were the most toxic. Aldrin, methoxychlor and malathion were the least toxic. Also 4 insecticides previously evaluated by topical application were tested in the field. In addition, phosphamidon not previously evaluated was included. The results showed that carbaryl was an excellent toxicant to the beetle. Endosulfan, trichlorfon and malathion at the dosages used were not effective. Phosphamidon was intermediate in effectiveness.

## الخلاصة

أجريت دراسة بالمختبر على اثني عشر مبيدا حشرياً لمعرفة أيهما أكثر سمية ضد خنفساء القثائيات . وقد دلت النتائج على أن المبيدات ميفنفس (فوسدرين) وكاربوريل (سيفن) وبراثيون كانت أكثرها فعالية . أما المبيدات الدرين وميثوكسيكلور وملاثيون فكانت أقلها فعالية .

وكذلك اختبر أربع مبيدات من التي أعطت نتائج جيدة في المختبر وجريت في الحقل للتأكد من فعاليتها ضد الحشرة تحت الظروف الطبيعية . وقد دلت النتائج على أن المبيدكاربوريل ( سيفن ) كان فعالاً جداً في مكافحة الحشرة .

## INTRODUCTION

The cucumber beetle, *Aulacophora foveicollis* Lucas, is an important pest of cucurbits in Iraq. Damage is caused by the adult beetles and the larvae. Adults feed on the seedlings and may cause death to the young plants. In later stages the beetles feed on leaves and flowers. The larvae feed on the roots and may cause the death of the plants.

Although the cucumber beetle was reported (Roa 1921) as a pest of cucurbits, no work, of which the writers know, has been reported from this country on the control of the insect. Malathion and DDT are recommended by the Department of Entomology, Ministry of Agriculture (1962) for the control of the insect. This research was carried out in 1964 and 1965 to find

the most effective insecticide for the control of the pest.

In measuring the relative toxicity of a number of insecticides to a particular pest, it is important to test such insecticides under field conditions where they will ultimately be used. This was recognized by Busvine (1957) when he wrote, "Logically, of course the best criterion is a full scale field trial; but such trials are expensive, slow and owing to the difficulty of providing adequate replications to make up for great variability; do not always

produce unambiguous conclusions. Therefore, they should be reserved till laboratory tests have narrowed the choice down to two or three substances."

Laboratory tests to evaluate several insecticides against the cucumber beetles were carried out in 1964 in the Department of Entomology, College of Agriculture, Abu Ghraib, Iraq. This was done in the hope of selecting the most toxic insecticides to the cucumber beetle to be tested in the field.

## MATERIALS AND METHODS

**Laboratory tests:** Tests were conducted in 1964 to determine the respective toxicities of 12 chlorinated hydrocarbons, organic phosphates and carbamate insecticides to the cucumber beetle adults. All insecticides tested were of technical grade with the exception of carbaryl, malathion, diazinon and trichlorfon which were 99% pure. Trithion was 95% pure.

The beetles used in these tests were obtained from untreated fields in the College of Agriculture and the Scientific Research Department at Abu-Ghraib. Beetles were collected and held in the laboratory in glass jars covered with cheese cloth for 24-48 hours before they were treated. The beetles were fed fresh cucumber leaves placed in the glass jars.

The LD<sub>50</sub> of each insecticide was determined by applying the insecticide to the abdominal sternites of

individual insects. The toxicant was dissolved in acetone and applied by a syringe microburet (El-Mosa *et al.* 1959). Two microliters of solution was applied to each beetle after the insect had been anesthetized with carbon dioxide. The carbon dioxide was obtained as a liquified gas in cylinders under pressure. The gas was allowed to escape through a pressure reducing valve at a slow rate through a 6 inch Buchner funnel in which the test insects were confined. At least four dose levels of each insecticide were used to determine the LD<sub>50</sub>. Four replicates of 10 beetles each were used at each dose level.

After treatment the beetles were held in pint-size ice cream cartons and transferred to a constant temperature cabinet at 25°C. Food and water were supplied to the treated insects. Mortality counts were made 24 hours after treatment. The



criterion for mortality was the inability of the insects to show active locomotion. Forty beetles were used to determine the average weight of a cucumber beetle. This was found to be 24.1mg. The LD 50 in terms of micrograms of insecticides per gram of beetle was determined by the probit analysis method (Finney 1952).

**Field experiment:** From the results obtained from the laboratory tests described previously it was possible to select the most promising insecticides to be tested in the field. Also, the safety factor for humans was taken into consideration in selecting the insecticides. The insecticides chosen were carbaryl, endosulfan, trichlorfon and malathion. Phosphamidon was also included. Malathion was ineffective in the laboratory and was included in the field experiment because it is recommended for the control of the cucumber beetle. The experiment was conducted in a field of cantaloupe at the college of Agriculture experimental farm. The field was planted on March 24, 1965. The experiment consisted of 5 treatments and untreated check, with 4 replications. Each plot was 4 rows wide and 50 square meters in size. Large volume conventional Knapsack sprayers were used to spray the different insecticides. The

amounts of insecticides used were calculated per donum area (donum = 2500m<sup>2</sup>) and the amount of water used was estimated by spraying water on a certain area of the field before spraying. The field was sprayed on July 15 and again on July 31, 1965. At 3 and 8 days after treatment five uninjured leaves were taken at random from each replicate, 20 per treatment. Three leaves from each treatment were placed in a petri dish and 10 cucumber beetles were introduced into each dish. This was replicated 3-6 times. The beetles used were collected from untreated fields in the College of Agriculture and were held in glass jars for 24-48 hours before testing.

Mortality counts were taken 12 and 24 hours after the beetles were introduced into the dishes containing the treated leaves. This method of evaluation was used because the beetle is a flying insect and it is difficult to take accurate counts in the field. The criterion for mortality was the inability of the insect to show active locomotion. Also the amount of leaf damage caused by beetle feeding was measured in each replicate by a plastic sheet divided into small squares of  $\frac{1}{4}$  square centimeter each. The insecticides used and dosages are shown in Tables 2, 3 and 4.

## RESULTS AND DISCUSSION

**Laboratory tests:** The LD50 in micrograms per gram of beetle, 95% confidence limits and slopes of the log. dose-probit lines for the 12 insecticides tested are presented in Table 1. The most effective



shows large LD50 and small slopes for aldrin, methoxychlor and malathion. This indicates that the beetles are resistant to the three insecticides, and resistance did not reach its limits. It is expected that the cucumber beetle will develop still greater resistance to aldrin, methoxychlor and malathion. It is difficult to ascertain whether this resistance is natural or acquired because the history of insecticidal use to control the pest is not known. Also Table 1 shows that carbaryl has small LD50 and large slope. This indicates that the cucumber beetle is susceptible to carbaryl. Both the LD50 and the slopes for mevinphos, parathion and dieldrin are small. One may speculate that there is a great heterogeneity in the cucumber beetle with respect to resistance to these insecticides and resistance is apt to develop.

It would be important to determine the LD50 for the insecticides tested from time to time to show how resistance varies. Besides the LD50, the slopes of the log. dose-probit line should be reported.

Field tests: The mean percent beetle mortality shown in Tables 2 and 3 demonstrates that carbaryl is an excellent toxicant to the cucumber beetle. At 12 hours after exposure the percent mortality was high. This indicates that carbaryl has fast action against the beetle. Also the percent mortality after 8 days of spraying was high. This shows that the insecticide has a long residual activity. Also Tables 2 and 3 show that endosulfan, trichlorfon and malathion at the dosages used were ineffective against the beetle. Phosphamidon was moderate in effectiveness.



**Table 2. Mean percent beetle mortality after 12 and 24 hours exposure to treated leaves taken 3 days after first and second sprays.**

Insecticide and formulation <sup>a/</sup>	Amount per Donum <sup>b/</sup>	First Spray		Second Spray	
		Mean percent mortality <sup>c/</sup>		Mean percent mortality <sup>d/</sup>	
		12 hrs.	24 hrs.	12 hrs.	24 hrs.
Carbaryl (Sevin) (85% S.P.)	167 Gm.	83.3	96.6	60.0	100.0
Phosphamidon (Dimecron) (50% S.)	286	38.3	71.6	50.0	93.3
Endosulfan (Thiodan) (35% E.C.)	422	20.0	33.3	3.3	36.7
Triclorfon (Dipterex) (80% S.P.)	175 Gm.	11.7	31.6	3.3	16.7
Malathion (50% E.C.)	989	11.6	30.0	0.0	3.3
Control		3.3	10.0	0.0	3.3
D.05 (Tukey Range test)–		40.2	40.1	51.9	19.9

a/ S.P.=Sprayable powder; S.=Soluble;  
E.C.=Emulsifiable concentrate; W.P.=  
Wettable Powder.

b/ Cubic centimeters unless otherwise noted.

c/ Based on 6 replications of 10 beetles  
each. Means paralleled by the same line  
are not significantly different.

d/ Based on 3 replications of 10 beetles  
each.

**Table 3. Mean percent beetle mortality after 12 and 24 hours exposure to treated leaves taken 8 days after first and second sprays.**

Insecticide and formulation <sup>a/</sup>	Amount per Donum <sup>b/</sup>	First Spray		Second Spray	
		Mean %		Mean %	
		mortality <sup>c/</sup> 12 hrs.	mortality <sup>c/</sup> 24 hrs.	mortality <sup>d/</sup> 12 hrs.	mortality <sup>d/</sup> 24 hrs.
Carbaryl (Sevin) (85% S.P.)	167 Gm.	50	76.7	99.3	100
Phosphamidon (Dimecron) (50% S.)	286	13.3	30.0	56.7	70
Endosulfan (Thiodan) (35% E.C.)	422	3.3	6.7	3.3	10
Triclorfon (Dipterex) (80% S.P.)	175 Gm.	10.0	13.3	3.3	20
Malathion (50% E.C.)	989	16.7	21.7	6.7	23
Control		1.7	8.3	20.0	20
D.05 (Turkey Range Test)		26.9	30.1	26.3	40.3

a/ S.P.=Sprayable powder; S. = Soluble;  
E.C.= Emulsifiable concentrate; W.P. =  
Wettable powder.

b/ Cubic centimeters unless otherwise noted.

c/ Based on 6 replications of 10 beetles  
each. Means paralleled by the same line  
are not significantly different.

d/ Based on 3 replications of 10 beetles  
each.

The amount of leaf feeding shown in Table 4 indicates that carbaryl is very toxic to the cucumber beetle because the amounts of leaf feeding in carbaryl treated

leaves were negligible. This confirms the results of the topical application and shows that Sevin is a strong contact insecticide to this insect.



**Table 4. Amounts of leaf feeding after 24 hours of exposing beetles to insecticides treated leaves taken 3 and 8 days after first and second sprays.**

Insecticide and formulation <sup>a/</sup>	Amount per Denum <sup>b/</sup>	First Spray		Second Spray	
		Average amounts of leaf feeding <sup>c/</sup>		Average amounts of leaf feeding <sup>d/</sup>	
		3 days	8 days	3 days	8 days
Carbaryl (Sevin) (85% S.P.)	167	.05	.63	0.00	.33
Phosphamidon (Dimecron) (50% S.)	286	6.60	1.00	3.43	9.33
Endosulfan (Thiodan) (35% E.C.)	422	8.60	3.83	4.33	17.66
Trichlorfon (Dipterex) (80% S.P.)	175	20.00	3.00	39.00	20.67
Malathion (50% E.C.)	989	12.30	16.16	43.66	19.00
Control	—	16.30	21.50	53.66	19.33
D.05 (Tukey Range Test)—	—	—	18.74	19.29	—

a/ S.P.=Sprayable Powder; S.=Souluble; E.C.=Emulsifiable concentrate; W.P.=Wettable Powder.

c/ In one fourth square centimeter based on 6 replications. Averages paralleled by the same line are not significantly different.

b/ Cubic centimeters unless otherwise noted.

d/ Based on three replications.

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etc. may be added to the year. If a statement is referred to by several publications, note the use of semicolons as in the example: Several workers (Saite et al., 1954; Kassem-sari, 1963; Jones and Murray, 1962) have found..... References should be carefully checked as to their authenticity. Each reference appearing in the list of references should be documented in the text. In the reference sheet which should be placed at the end of the manuscript references are arranged alphabetically according to the last name of the first author, and in the following order: Author's last name, year, title, name of Journal (underlined and abbreviated in accordance with the World list of Scientific Periodicals), volume, number and pages. Books may be referred to as follow: author(s) name, year, title (title of book underlined), city where published, publisher and page.

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