

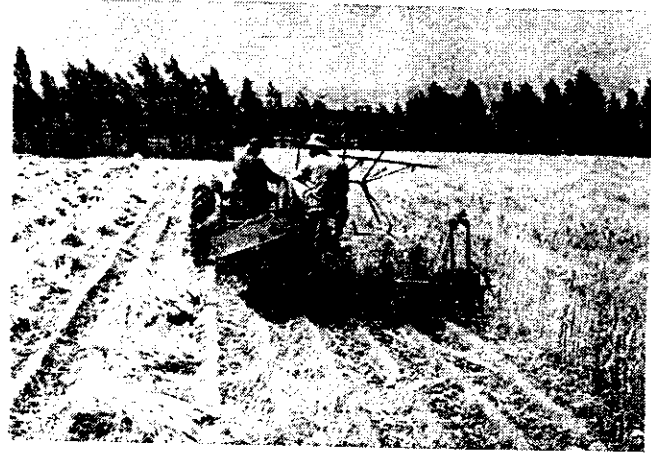
W O R
253/23

République Libanaise
Bureau du Ministre d'Etat pour la Réforme Administrative
Centre des Projets et des Etudes sur le Secteur Public
(C.P.E.S.P.)

Republic of Lebanon
Office of the Minister of State for Administrative Reform
Center for Public Sector Projects and Studies
(C.P.S.P.S.)

الجمهورية اللبنانية
مكتب وزير الدولة لشؤون التنمية الإدارية
مركز مشاريع ودراسات القطاع العام

VARIETAL AND CULTURAL TRIALS
WITH SMALL GRAINS
AND OIL CROPS
IN THE
BEQA'A, LEBANON,
1958-1963



Harvesting foundation seed of barley

Faculty of Agricultural Sciences
AMERICAN UNIVERSITY OF BEIRUT

Publication No. 23
February 1964

WOK
253/23

29 AVR. 1988

VARIETAL AND CULTURAL TRIALS
WITH SMALL GRAINS
AND OIL CROPS
IN THE
BEQA'A, LEBANON,
1958-1963



by
W.W. WORZELLA, S. ABU SHAKRA
and
H. NASR

Faculty of Agricultural Sciences
AMERICAN UNIVERSITY OF BEIRUT

Publication No. 23
February 1964

CONTENTS

	Page
INTRODUCTION	5
MATERIALS AND METHODS	6
EXPERIMENTAL RESULTS	7
SMALL GRAINS	8
Wheat Variety Trials	8
Barley Variety Trials	8
Oat Variety Trials	9
OIL CROPS	10
Soybean Variety Trials	10
Safflower Variety Trials	11
Sunflower Variety Trials	12
Castor Bean Trials	13
CULTURAL PRACTICES	13
Rate of Seeding and Row-Width on Wheat Yield	13
Rate of Seeding and Row-Width on Wheat Protein	15
Rate of Seeding and Row-Width on Soybean Yield	16
SUMMARY	18
LITERATURE CITED	19

VARIETAL AND CULTURAL TRIALS
WITH SMALL GRAINS AND OIL CROPS
IN THE BEQA'A, LEBANON, 1958-1963

by

W.W. Worzella, S. Abu Shakra and H. Nasr*

INTRODUCTION

The total amount of seed obtained per dunum from small grains and oil crops is affected greatly by the variety and the cultural practices used. In Lebanon most of the present varieties have been grown for many years. Planting of the field crops is usually done by broadcasting the seed by hand and covering it with a furrow-plow. According to Ecimovic and El-Assaad (4) 1,109,926 dunums of wheat and 262,563 dunums of barley were planted in Lebanon in 1960 of which more than half of this was grown in the Beqa'a. Detailed records are not available as to the production of oats, soybeans, safflower, sunflower and castor beans, however, these are grown in this area only on a few hundred dunums.

Large quantities of food and feed grains are imported into Lebanon each year since the number of dunums available for the planting of these crops are limited. However, much higher yields could be obtained

* Professor of Agronomy, Instructor in Agronomy and Assistant Instructor in Agronomy, respectively, Faculty of Agricultural Sciences, American University of Beirut, Beirut, Lebanon. Appreciation is extended to the Lebanese Chemical Company for their assistance and cooperation in this work. The authors gratefully acknowledge the assistance of the graduate students, M. Abul-Hussain, S.M. Ali, M. Faizullah and M.A.Q. Shaikh for some of the data from their M.S. thesis and to Yusuf Khashadurian, Farm Superintendent at the Agricultural Research and Educational Center.

with improved adapted varieties and good cultural production practices. Research involving trials with varieties of small grains and oil crops as well as more efficient methods of production is limited in this area.

The present study was undertaken to evaluate the relative performance of local and introduced varieties and cultural methods in order to stabilize and increase yield. The investigations included: (a) variety trials on three small grain and four oil crops and (b) rate of seeding and row-width studies with wheat and soybeans. The study was conducted at the Agricultural Research and Educational Center of the American University of Beirut in the Beqa'a, Lebanon during the 5-year period 1958 to 1963.

MATERIALS AND METHODS

The experiments were conducted under dryland and irrigated conditions at the Agricultural Research and Educational Center located in the northern central Beqa'a plain, Lebanon. The annual rainfall received at the Center varied from 219 mm. in 1959-60 to 525 mm. during 1962-63 with an average of 376.5 mm. for the eight year period of 1955 to 1963. The soil is high in clay content, low in organic matter and phosphorus content, high in potassium content and is calcareous with a pH of about 8.0.

The dryland experimental plots received an annual uniform application of 4 kg. of each of P_2O_5 and nitrogen per dunum (1000 sq. meters). For the irrigated plots 20 kg. of P_2O_5 and 12 kg. of nitrogen per dunum were used. The fertilizer was broadcasted and worked into the soil by disking a few days before the planting of the crop. Diseases and insects were controlled immediately when first observed with fungicides and insecticides. Weeds were controlled by hoeing and cultivation. The oil crops were irrigated every seven days by a sprinkler system in the early stages and later through surface furrows made adjacent to the rows. A good seed bed was prepared and the seed planted with the regular nursery equipment using the appropriate rates of seeding for the various crops. The small grains were planted in November and the oil crops in April and May.

The field experiments were laid out in a randomized block or split plot design with each treatment replicated four times. For the small

grain variety trials each plot contained three rows, each row 4.5 meters long and 25 cm. apart. Four meters from the center row were harvested for the yield (Figure 2).

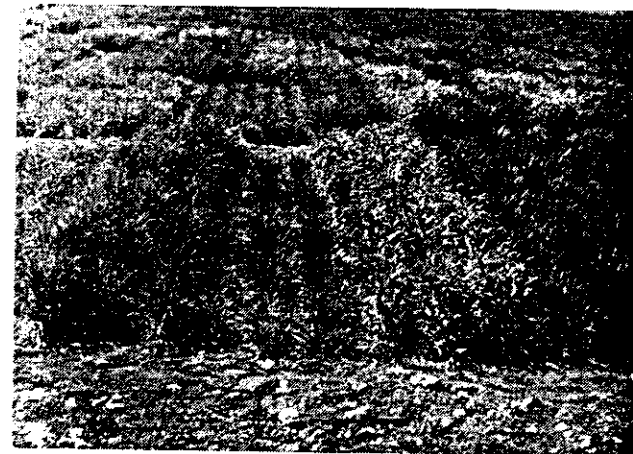


Figure 2. Small grain variety plots

The plots for the dryland cultural practices studies on wheat were 2 by 18 meters in size and were planted with a grain drill. Five one square meter areas, taken at random from each plot, were harvested for the yield data. For the oil crops each plot contained two or three rows, each row five meters long and either 50 cm. or 75 cm. apart depending upon the crop. Four meters of the center row or of the two rows were harvested for the grain yield. The crops were harvested when mature and threshed with the usual nursery equipment. The statistical analysis methods used were according to those described by Snedecor (7) and Cochran and Cox (3).

EXPERIMENTAL RESULTS

The data for the seed yields are reported in kilograms per dunum and for protein in percentage of air dry weight. The results of the various experiments will be discussed under small grains, oil crops and cultural practices.

SMALL GRAINS

Wheat Variety Trials

Four varieties of wheat grown extensively in the area were tested for yield under dryland conditions in the northern central Beqa'a plain. The data are shown in Table 1.

Table 1. Average yield of wheat varieties grown under dryland in the Beqa'a during the 5-year period 1958-1963.

Variety	Grain yields - kgs. per dunum					Average
	1958-59	1959-60	1960-61	1961-62	1962-63	
Hurani	72	139	176	116	101	120.8
Senator Capelli	65	105	140	75	86	94.2*
Florence Aurore	52	165	170	122	202	142.2*
Mishraqani	62	200	129	90	180	132.2

* Averages vary significantly at the 5 percent level.

It will be noted that Senator Capelli, a late maturing durum wheat, produced the least amount of grain during four of the five years of the trials with an average yield of 94.2 kg. per dunum. The variety Florence Aurore performed best during the same period with an average of 142.2 kg. per dunum. The varieties Hurani and Mishraqani were intermediate in yield. The relatively high yields obtained in 1959-60, a dry year with only 219 mm. of rainfall, was the result of adding one supplementary irrigation to the nursery in order to save the germ plasm of other strains planted adjacent to the yield trials.

Barley Variety Trials

Introduced and locally grown barley varieties were tested for yield during the 5-year period, 1958-63. The yield data for five varieties of barley are reported in Table 2.

Although the barley varieties do not vary significantly in the average grain yield per dunum they vary widely in other agronomic characteristics. Baladi and Tel Amara No. 25 are local two-row types grown extensively in the area, while Athinai and Arivat are introduced

Table 2. Average yield of barley varieties grown under dryland in the Beqa'a during the 5-year period 1958-1963.

Variety	Grain yield - kg. per dunum					Average*
	1958-59	1959-60	1960-61	1961-62	1962-63	
Athinai	250	238	344	347	333	302.4
Baladi (local)	162	272	340	442	329	309.2
Arivat	—	—	277	365	407	—
Tel Amara No. 25	202	240	314	470	323	310.0
Benito	—	223	172	366	335	—

* Averages do not differ significantly at the 5 percent level.

6-row varieties. Athinai matures from one to two weeks earlier than local varieties but the awns adhere strongly to the grain making it difficult to thresh and obtain awn-free seed. Arivat, in addition to producing satisfactory grain yields, grows rapidly and vigorously and provides forage for pasture early in the spring. Benito, an early two-row introduced variety, possesses a short straw.

Oat Variety Trials

Oats are not grown very much in this region for grain but provide excellent pasture for livestock early in the spring. Four introduced varieties of oats were tested for grain yield during the past five years and the data are reported in Table 3. Average yields of 150 to 183 kg.

Table 3. Average yield of oat varieties grown under dryland in the Beqa'a during the 5-year period 1958-1963.

Variety	Grain yield - kg. per dunum					Average*
	1958-59	1959-60	1960-61	1961-62	1962-63	
Ventura	198	74	223	202	120	163.4
White Algerian	185	195	195	238	113	183.2
Red Algerian	182	137	203	252	134	181.6
Nortex	124	58	228	186	154	150.0

* Averages do not differ significantly at the 5 percent level.

per dunum were obtained from the varieties studied. Unless better adapted varieties are obtained it appears that oats cannot compete with the higher yielding barley varieties for feed grain.

OIL CROPS

Soybeans Variety Trials

Fourteen soybean varieties have been appraised for their yield and other agronomic characteristics. The data on yield for the varieties, when grown under irrigation, are shown in Table 4, and that for height and maturity in Table 5.

It will be noted that the seed yields of soybeans were influenced greatly by both season and variety. The 1959 and 1963 seasons were less favorable for soybean production than were the other three seasons in the study. The 1961 season producing the highest yields of soybeans.

Table 4. Average yield of soybean varieties grown under irrigation in the Beqa'a during the 5-year period 1959-1963.

Variety	Seed yields - kg. per dunum					Average		
	1959	1960	1961	1962	1963	2-year 1962-63	3-year 1959-61	5-year 1959-63
Hawkeye	112	280	345	169	169	169.0	245.7	215.0
Ford	147	319	339	244	192	218.0	268.3	248.2
Lincoln	191	280	336	272	148	210.0	269.0	245.4
Clark	157	325	348	417	184	300.3	277.7	286.0
Wabash	167	293	432	282	169	225.5	287.3	268.6
Perry	188	242	268	265	202	233.5	232.7	233.0
Grant	83	185	276	—	—	—	181.3	—
Black Hawk	107	244	244	—	—	—	198.3	—
Chippewa	125	237	225	—	—	—	195.7	—
Adams	157	238	299	—	—	—	231.3	—
Shelby	—	—	—	219	221	220.0	—	—
Lindorin	—	—	—	242	191	216.5	—	—
Harosoy	—	—	—	323	191	257.0	—	—
Kent	—	—	—	335	189	262.0	—	—
LSD (5% level)	61	53	62	75	19	33.2	30.8	23.6



On the bases of the 5-year average the varieties Clark and Wabash performed best with seed yields of 286.0 and 268.6 kg. per dunum, respectively. Both varieties utilized the full growing season, and attained plant heights of 105 cm. for Clark and 120 cm. for Wabash. Perry, a late maturing variety, and Lincoln produced satisfactory seed yields. Of the earlier maturing varieties Ford produced an average yield of 248.2 kg. per dunum. The very early variety Grant, when planted in April, yielded during 1959-61, only 181.3 kg. per dunum, but was ready to harvest one month before the full season varieties.

Safflower Variety Trials

Five varieties of safflower were tested for yield during the 5-year period 1959-63 and the data are given in Table 6. It will be noted that the local variety performed best with an average yield of 305 kg. per dunum.

Table 5. Average plant height and date of maturity of soybean varieties grown under irrigation in the Beqa'a during the 5-year period 1959-1963.

Variety	Average plant height			Average date of maturity		
	2-year 1962-63	3-year 1959-61	5-year 1959-63	3-year 1962-63	3-year 1959-61	5-year 1959-63
Hawkeye	118	84	98	Sept. 24	Sept. 16	Sept. 19
Ford	116	85	91	Sept. 23	Sept. 17	Sept. 19
Lincoln	111	88	97	Oct. 7	Sept. 23	Sept. 29
Clark	122	93	105	Oct. 8	Oct. 1	Oct. 4
Wabash	134	110	120	Oct. 2	Sept. 28	Sept. 30
Perry	125	100	110	Oct. 8	Oct. 13	Oct. 11
Grant	—	62	—	—	Sept. 2	—
Black Hawk	—	75	—	—	Sept. 14	—
Chippewa	—	70	—	—	Sept. 10	—
Adams	—	74	—	—	Sept. 24	—
Shelby	116	—	—	Sept. 23	—	—
Lindorin	107	—	—	Sept. 15	—	—
Harosoy	117	—	—	Sept. 15	—	—
Kent	107	—	—	Oct. 4	—	—

Table 6. Average yield of safflower varieties grown under irrigation in the Beqa'a during the 5-year period 1959-1963.

Variety	Seed yield - kg. per dunum					Average
	1959	1960	1961	1962	1963	
Nebraska 6	167	331	147	234	324	242.0
Nebraska 8	159	375	124	198	373	245.4
Nebraska 10	127	212	95	—	—	—
Utah	127	358	202	246	306	227.8
Local	203	397	298	309	318	305.0*

* The average yield is significantly higher than the other varieties.

Sunflower Variety Trials

The results of the sunflower variety tests conducted during the 4-year period 1960-63 are reported in Table 7. The variety Mennonite was grown for four years while the other varieties were tested for two years. Further trials are necessary to appraise the relative yielding ability of the sunflower varieties. However, the over-all seed yields

Table 7. Average yield of sunflower varieties grown under irrigation in the Beqa'a during the 4-year period 1960-1963.

Variety	Seed yield - kg. per dunum				Average	
	1960	1961	1962	1963	2-year	2-year*
					1960-61	1962-63
Sunrise	152	257	—	—	204.5	—
Adv. Hybrid	188	175	—	—	181.5	—
Mennonite	258	280	192	235	269.0	215.0
Acc. 14024	—	—	258	305	—	281.5
Acc. 14027	—	—	266	277	—	271.5
Acc. 12032	—	—	291	278	—	284.5
Acc. 14035	—	—	246	284	—	265.0
Acc. 14037	—	—	275	296	—	285.5

* Differences in yield of less than 42 kg. per dunum are not statistically significant.

obtained from sunflowers compare favorably with the yields of other oil crops grown under similar conditions.

Castor Bean Trials

Three introduced strains of castor beans were appraised for yield during 1958-1961. The data are presented in Table 8. The three castor bean strains yielded about the same, however, the amount of seed produced per dunum is less for castor beans than for the other oil crops studied.

Table 8. Average yield of castor bean varieties grown under irrigation in the Beqa'a during the 3-year period 1959-1961.

Variety	Seed yield - kg. per dunum			Average*
	1959	1960	1961	
Sel. 480-2-47	124	199	249	190.7
Sel. 478-2-9-48	128	183	238	183.0
Sel. 481-1-2149	145	193	223	187.0

* Averages do not differ significantly at the 5 percent level.

CULTURAL PRACTICES

The growing of wheat in this area has not changed to any degree for many years. In general wheat is sown broadcast at a rate of 18 to 20 kg. per dunum and covered with a furrow plow. This rate of seeding is considered high and with pertinent data obtained in this region, the amount of seed may be reduced.

Rate of Seeding and Row-Width on Wheat Yield

The effect of rate of seeding and row-width on the grain yield of winter wheat, grown under dryland conditions in the Beqa'a, was studied during the 4-year period 1959-1963. The rates of seeding were 6, 10 and 14 kg. per dunum. At each seeding rate the wheat was planted in rows 15, 30 and 45 cm. apart. The variety Senator Capelli was used during the first two years and Florence Aurore the last two years. The yield for the seeding rates and row-width spacings are reported in Tables 9 and 10.

Table 9. Effect of rate of seeding on the grain yield of winter wheat grown under dryland in the Beqa'a during the 4-year period 1959-1963.

Rate of seeding (kg. per du.)	Grain yields - kg. per dunum				Average ⁺
	1959-60*	1960-61*	1961-62**	1962-63**	
6	58	214	195	116	145.8
10	70	239	194	110	153.3
14	98	241	182	99	155.0

+ Averages do not differ significantly at the 5 percent level.

* Data from M.S. Thesis 1961 by Faizullah (5).

** Data from M.S. Thesis 1963 by Abul Hussain (1).

Table 10. Effect of row-width spacing on the grain yield of winter wheat grain under dryland in the Beqa'a during the 4-year period 1959-1963.

Row-width spacings (cm.)	Grain yields - kg. per dunum				Average ⁺
	1959-60*	1960-61*	1961-62**	1962-63**	
15	83	245	187	111	156.5
30	48	249	187	107	147.7
45	94	200	197	107	149.5

+ Averages do not differ significantly at the 5 percent level.

* Data from M.S. Thesis 1961 by Faizullah (5).

** Data from M.S. Thesis 1963 by Abul Hussain (1).

It will be noted that varying the seeding rate of wheat from 6 to 14 kg. per dunum did not influence the resulting yield significantly. On the average wheat planted at the rate of 6, 10 and 14 kg. produced 145.8, 153.3 and 155.0 kgs. per dunum, respectively. Likewise row-width spacings of 15, 30 and 45 cm. between the rows did not affect the yield in wheat.

On the basis of the 4-year results it is evident, that under dryland conditions similar to those found in the Beqa'a, satisfactory yields can

be obtained by sowing with a grain drill only 6 kg. of seed per dunum, or one-third of that used by the broadcast method. By the use of machinery and improved methods of planting a considerable amount of seed can be saved in the area without reducing the yield per dunum.

Rate of Seeding and Row-Width on Wheat Protein

The protein data from wheat sown at various seeding rates and row-width spacings are reported in Tables 11 and 12. The data show that planting wheat at 6, 10 and 14 kg. per dunum in different row-

Table 11. Effect of rate of seeding on the protein content of winter wheat grain under dryland in the Beqa'a during the 4-year period 1959-1963.

Rate of seeding (kg. per du.)	Protein percentage				Average ⁺
	1959-60*	1960-61*	1961-62**	1962-63**	
6	16.5	15.9	13.0	11.4	14.2
10	16.5	16.0	12.9	11.0	14.1
14	17.0	16.6	12.6	11.0	14.3

+ Averages do not differ significantly at the 5 percent level.

* Data from M.S. Thesis, 1961 by Faizullah (5).

** Data from M.S. Thesis, 1963 by Abul Hussain (1).

Table 12. Effect of row-width spacing on the protein content of winter wheat grown under dryland in the Beqa'a during the 4-year period 1959-1960.

Row-width spacings (cm.)	Protein percentage				Average
	1959-60*	1960-61*	1961-62**	1962-63**	
15	16.7	16.2	12.8	11.0	14.2
30	16.6	16.2	12.8	11.2	14.2
45	16.6	16.2	12.8	11.1	14.2

* Data from M.S. Thesis, 1961 by Faizullah (5).

** Data from M.S. Thesis, 1963 by Abul Hussain (1).

width spacings did not change the protein content in the grain. A higher protein percentage in the grain was obtained during the first two years of the study. This may be due to the lower rainfall received during these two years as well as the use of the durum variety Senator Capelli.

Rate of Seeding and Row-Width on Soybean Yield

Various rates of seeding for soybean were established by planting the seed, 2, 3 or 4 cm. apart in rows that were spaced, 25, 50 or 75 cm. apart. The seeding rates varied from 6 kg. of seed per dunum (4 cm. by 75 cm. rows) to 35 kg. per dunum (2 cm. by 25 cm. rows). Three varieties of soybeans, varying in maturity, were used at each rate of planting. The yield data for soybeans planted at various rates of seeding in different row-widths for the 3-year period 1961-63 are reported in Tables 13 and 14.

An analysis of the data in Table 13 shows that planting soybeans seeds 2, 3 or 4 cm. apart within the row had little, if any, affect on the resulting yield. Slightly lower yields were obtained where the plants were spaced 4 cm. within the row, especially in the 75 cm. rows.

The yields of soybeans were higher when planted in 25 and 50 cm. rows as compared to the yields obtained from 75 cm. rows (Table 14). The average yields for the 25, 50 and 75 cm. row spacings were 305.0, 288.7 and 243.3 kg. per dunum, respectively.

Table 13. Effect of rate of seeding on the yield of soybean grown under irrigation in the Beqa'a during the 3-year period 1961-1963.

Within row spacing of soybeans (cm.)	Seed yield - kg. per dunum			Average ⁺
	1961*	1962	1963**	
2	245	310	269	274.7
3	256	310	257	278.3
4	250	286	256	264.0

⁺ Averages do not differ significantly at the 5 percent level.

* Data from M.S. Thesis 1962 by Ali (2).

** Data from M.S. Thesis 1964 by Shaikh (6).

For environmental conditions similar to those in the Beqa'a, Lebanon, satisfactory soybeans yields can be produced under irrigation by using from 9 to 12 kg. of seed per dunum planted in rows 50 cm. apart. Soybeans planted in rows narrower than 50 cm. are more difficult to irrigate and weeds become difficult to control.

Table 14. Effect of row-width spacing on the yield of soybeans grown under irrigation in the Beqa'a during the 3-year period 1961-1963.

Row-width spacings (cm.)	Seed yield - kg. per dunum			Average
	1961*	1962	1963**	
25	274	365	276	305.0
50	298	298	270	288.7
75	251	243	236	243.3
LSD (5% level)	23	34	21	27.0

* Data from M.S. Thesis 1962 by Ali (2).

** Data from M.S. Thesis 1964 by Shaikh (6).

SUMMARY

Trials were conducted to evaluate the relative performance of local and introduced varieties and cultural methods in order to stabilize and increase crop yields in the area. The investigations included: (a) variety trials on three small grain and four oil crops and (b) rates of seeding and row-width studies with wheat and soybeans. The study was conducted at the Agricultural Research and Educational Center of the American University of Beirut in the Beqa'a, Lebanon, during the 5-year period 1958-63.

Varieties of wheat were found to vary in their yielding ability with Florence Aurore performing best under dryland conditions. The barley and oat varieties tested did not exhibit wide differences in average grain yield, however, they varied in maturity, plant height and quality.

The seed yields varied widely for the different varieties of soybeans and safflower when grown under irrigated conditions. On the basis of the 5-year average the soybean varieties Clark and Wabash performed best with seed yields of 286 and 269 kg. per dunum, respectively. For safflower the local variety produced the highest yield with an average of 305 kg. per dunum.

The yield differences between the varieties of sunflower and castor beans tested were small. An introduced sunflower strain, Acc. 14037, produced an average of 286 kg. of seed per dunum for the 2-year period 1962-63. The average yields from the castor beans were lower than those obtained from the other oil crops when grown under similar conditions. The highest yielding strain of castor beans, Sel. 480-2-47, produced an average of 191 kg. of seed per dunum for the 3-year period 1959-61.

Planting wheat under dryland conditions at the rate of 6, 10 and 14 kg. per dunum did not influence the resulting grain yield. Likewise, row-width spacing of 15, 30 and 45 cm. between the rows did not affect the yield of wheat. By the use of machinery and improved methods of planting a considerable amount of seed can be saved in the area without reducing the yield per dunum.

The protein content of wheat grown under dryland conditions was not affected by different rates of seeding or various row-width plantings.

The planting of soybean seeds at 2, 3 and 4 cm. apart within the row had little, if any, affect on the resulting yield. The yields of soybeans were higher when planted in 25 and 50 cm. rows than when sown in 75 cm. rows. For environmental conditions similar to those in the Beqa'a, Lebanon, satisfactory soybean yields can be produced by using from 9 to 12 kg. of seed per dunum planted in rows 50 cm. apart.

LITERATURE CITED

1. Abul-Hussain, M. Effect of row-width and rate of seeding on the yield and other characteristics in wheat. M.S. Thesis, Faculty of Agricultural Sciences, American University of Beirut, 1963.
2. Ali, S.M. Effect of spacing of plants between and within rows on yield and other characteristics in soybeans. M.S. Thesis, Faculty of Agricultural Sciences, American University of Beirut, 1962.
3. Cochran, W.C. and Cox, G.M. *Experimental Design*. John Wiley and Sons, Inc. New York 2nd Ed. 1957.
4. Ecimovic, J.P., and El-Assaad. Sampling census of Agriculture Lebanon, 1960. Ministry of Agriculture R-6: I-75, Beirut, May 1961.
5. Faizullah, M. Effect of row-width and rate of seeding on plant characteristics in wheat. M. S. Thesis, Faculty of Agricultural Sciences, American University of Beirut, 1961.
6. Shaikh, M.A.Q. Effect of populations and spacing on yield and other characteristics in soybeans. M. S. Thesis, Faculty of Agricultural Sciences, American University of Beirut, 1964.
7. Snedecor, G.W. *Statistical Methods*. Iowa State College Press, Inc. 4th Ed. 1946.

Republic of Lebanon

Office of the Minister of State for Administrative Reform

Center for Public Sector Projects and Studies

(C.P.S.P.S.)

الجمهورية اللبنانية
مكتب وزير الدولة لشؤون التنمية الإدارية
مركز مشاريع ودراسات القطاع العام