J. Agric. Sci. Mansoura Univ., 29 (11): 6049 - 6062, 2004

EFFECT OF INTERCROPPING MAIZE AND SUNFLOWER ON SOYBEAN YIELD AND ITS COMPONENTS UNDER TILLAGE SYSTEMS IN RECLAIMED LAND

Nawar, F.R.R.
Field Crops Research Institute, Agric. Res. Center, Giza, Egypt

ABSTRACT

Two field experiments were conducted at Nubaria Agric. Res. Station during 2000 and 2001 seasons. The objectives of this investigate was aimed to study the effect of tillage systems (conventional tillage and no-tillage) and four intercropping patterns: 1) Pure stand of soybean was sown in hills 10 cm on each side of ridge (120 cm) with two plants/hill. Pure stand of sunflower and maize were sown in hills 30 cm on each side of the ridge with one plant/hill. 2) Soybean seeds were sown on one side of the ridge and sunflower was sown on the other side of the ridge and maize was sown on the middle .3) Soybean was sown on the middle of the ridge among maize and sunflower plants, and 4). Soybean was sown on one side of the ridge, and maize was sown on the other side of the ridge and sunflower was sown in the middle on the ridge . A split plot design with four replicates was used.

Results showed that tillage systems and intercropping treatments significantly affected plant height, number of pods/plant, number of seeds/plant, seed yield/plant, seed yield/feddan and oil seed percentage. The highest seed yield/feddan was obtained from tillage conservation in the two seasons compared to no-tillage. Also, pure stand gave higher seed yield of soybean than that of intercropping treatments. The results indicated thatthe interaction between tillage systems and intercropping treatments interaction had a significant effect on plant height, number of pods/plant, number of seeds/plant and seed yield/feddan. The highest seed yield/feddan was obtained by tillage system and soybean which sown on one side of the ridge. The results indicated that tillage system, intercropping treatments and interactions between tillage system and intercropping patterns had a significant effect on grain yield of maize and sunflower seed yields/ feddan. Pure stand of maize and sunflower gave higher maize grain yield and sunflower seed yield/fed than that of intercropping patterns. It can be concluded that sown soybean on one side of the ridge 120cm apart and 10 cm between hills with tillage conservation could be recommended for raising soybean productivity under the conditions of Nubaria area.

INTRODUCTION

Intercropping may be a way to increase the productivity of unit area. Soybean, sunflower and maize are commonly suggested as desirable intercrop species because different grown rate of these spacing should allow full utilization of the environment competition for light.

From the other side, conservation tillage system may provide better germination and seedling growth under cool and wet spring soil conditions. Garcia and Pinchinat (1976) found that intercropped planting as (100% maize + 50% sorghum and 100% soybean + 50% of maize) did not reduce crop yield (maize and soybean yields). But, in planting (100% soybean + 100% maize) maize and soybean recorded the highest yield. Beets (1977) reported that intercropping maize with soybean in different special arrangement, i.e. (100% + 8%, 75% + 25%, 50% + 50%, 25% + 75% and 8% + 100% from

(1979) noticed that soybean yield was 0.58 t/ha in the intercropping and was the highest with lower fertilizer rate (NPK) 75:50:25 kg/ha.

Galal *et al.*(1980) studied soybean and maize grown together in different patterns at different sites in Egypt. They found that pods and seeds number per plant were 30.50% higher and seed yield was 50% greater in soybean grown alone than with maize. Mohta and R. De (1980) found that seed yield of soybean intercropped was less than that of a solid crop. The combined seed/grain yield of the two crops in an intercrop was more than the individual components. Galal and Metwally (1982) mentioned that the intercropping reduced seed yield by more than 40% of seed yield under monoculture. Other yield components such as number of pods and seeds per plant and 100-seed weight were also significantly reduced.

Moursi *et al.*(1983) found that planting maize at narrow spaces gave aggressively positive values for maize, whereas in the wide spaces these values were positive in favour of soybean. Tetiokagho (1988) found that soybean yield decreased with increasing maize density. Abd El-Gawad *et al.*(1989a) found that the highest seed yield/fed. of soybean was obtained by planting sunflower and soybean at 30 cm ridge width with 3:3 intercropping patterns. Dhingra *et al.*(1991) found that maize gave higher yield in intercrop in 1983 and 1985 only. Average yield of maize over 4 years was highest (3.69 t/ha) when grown in alternate row with mungbean. Also, several studies were made on intercropping soybean with maize (Ujjinaiah *et al.*, 1991; Weil and Cfadden, 1991 and El-Douby *et al.*,1993). Varughese and Iruthayaraj (1996) showed that grain yield was unaffected by cropping system, except in Kharif (monsoon) of 1989 when it was highest with intercropping in a 2:2 row ratio.

Thus, this work was designated to study the effect of tillage systems and some crops intercropped on soybean yield productivity in reclaimed land.

MATERIALS AND METHODS

Two field experiments were carried out at Nubaria Agric. Res. Station during the two successive growing seasons of 2000 and 2001. The major objective of this study was to investigate the effect of tillage system and intercropping patterns on yield and its components, seed oil percentage and seed protein content of soybean plants.

The study included 8 treatments divided into four treatments intercropped patterns and two tillage systems.

1. The tillage systems were:
   a) No-tillage.
   b) Complete tillage.
2. The intercropping treatments were as follows:
   i) Soybean in solid stand planted in hills 10 cm on each wide ridge (120 cm)with two plants/hill.
   ii) Sunflower and maize in solid stand in hills 30 cm on each side of the ridge with one plant/hill.

iii) Soybean was sown on one side of the ridge in hills 10 cm apart with two plants/hill and sunflower was sown on the other side 2 of the ridge and maize was sown in the middle ridge .

iv) Soybean was sown in the middle ridge among sunflower and maize in hills 10 cm apart with two plants/hill.

v) Soybean was sown on the other side of the ridge in hills 10 cm apart with two plants/hill and maize was sown on one side of the ridge and sunflower was sown in the middle of the ridge .

Mechanical and chemical analysis of the experimental site are presented in Table 1. A split plot design with four replications was used. The tillage system occupied the main plots. The four intercropping treatments were arranged in sub-plots. The plot area was 28.8 m^2 and included six wide ridges each 4 m length and 120 cm width.

Table 1: Mechanical and chemical analysis of the experimental soil in 2000 and 2001 seasons.

Soil properties	Season	
	2000	2001
Soil particles, %		
Sand, %	52.9	53.3
Silt, %	21.8	20.8
Clay, %	25.3	25.9
Soil texture	sandy clay loam	sandy clay loam
Chemical properties		
Total N, %	0.046	0.051
Available N (ppm)	26.30	26.6
Available P (ppm)	9.68	8.4
Available K (ppm)	425.0	403.0
pH	8.2	8.1
E.C., mmhos/cm	2.21	1.95
O.M., %	0.95	0.98
$CaCO_3$, %	22.9	22.5

Giza 2 open pollinated maize variety was used at the overstory crop Majac sunflower variety and Crawford as early soybean cultivar from IV Group was used. Soybean was sown on May 15th in the first season and on May 17th in the second season. Whereas, sunflower and maize were sown in June 7th in the first season and in June 10th in the second season. Soybean seeds were mixed at sowing with the recommended soybean inoculation. Plants were thinned to two plants/hill. Also, maize and sunflower were thinned to one plant/hill after 16 days from sowing. Other cultural practices were carried out as recommended.

At harvest, 10 plants were randomly taken from the middle ridges of each plot to measure plant height (cm), number of pods/plant, number of seeds/plant, 100-seed weight (g) and seed yield/plant (g). Seed yield per feddan was estimated from the whole plot. Also, seed yield of sunflower and grain yield/fed. Oil content of soybean seeds was determined by Soxhlet apparatus on dry weight basis as described by Sorenson (1947). Protein was determined as total nitrogen by micro-Kjeldahl method according to A.O.A.C.

(1970), then multiplied by 6.25 (Tripathi *et al.*, 1971) to obtain protein content in soybean seeds.

The collected data were statistically analyzed to the proper design according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

A. Soybean

1. Effect of tillage system

The results presented in Tables (2 and 3) indicated that tillage system had significant effect on plant height, number of pods/plant, number of seeds/plant, seed yield/plant, seed yield/feddan and oil seed percentage in the two seasons.

It was clear from this tables that tillage systems gave the highest value for all studied characters, except 100-seed weight and seed oil content in two seasons. These results indicate clearly that conservation tillage system may provide better germination and seedling growth compared to no-tillage. The highest value of seed yield/feddan was obtained from conventional tillage compared to no-tillage. Similar results were also reported by Beets (1974) and Garcia and Pinchinate (1976).

2. Effect of intercropp patterns

The results presented in Tables 2 and 3 show that all studied characters were significantly affected by intercropped crops, except 100-seed weight and seed protein content in the two seasons. The pure stand gave the highest value for all studied characters compared to intercropped treatments. Soybean which was sown in middle the wide ridge among maize and sunflower gave the lowest seed yield compared to that sown on one side of the ridge .

The results presented in Tables 2 and 3 indicated that no significant differences were found between soybean sown on one side of the ridge and other side of the ridge for all the studied characters, except oil percentage. Similar results were also reported by Galal *et al.*(1980), Mohta and R. De (1980), Moursi *et al.*(1983), Dhingra *et al.*(1991), El-Douby *et al.*(1993) and Varughese and Iruthayaraj (1996).

3. Interaction effects

The results presented in Tables 4 and 5 revealed that the interaction between tillage systems and intercropping patterns had significant effect on plant height, number of pods/plant, number of seeds/plant and seed yield/feddan in the two seasons. The highest seed yield/fed. was obtained by sowing soybean on one side of the wide ridge and conventional tillage. Similar results were reported by Moursi *et al.*(1983), Abd I-Gawad *et al.*(1989b) and Dhingra *et al.*(1991).

B. Maize and sunflower

The results presented in Tables 6, 7, 8 and 9 revealed that the tillage systems, intercropping treatments and interaction between tillage system and intercropping treatments had significant effect on grain yield and sunflower seed yield. The pure stand gave the highest values compared to intercropped treatments.

Table 2: Average of plant height, number of pods/plant, number of seeds/plant and 100-seed weight of soybean plants as affected by tillage systems and intercropping treatments in 2000 and 2001 seasons.

Treatments	Plant height (cm)		Number of pods/plant		Number of seeds/plant		100-seed weight (g)	
	2000	2001	2000	2001	2000	2001	2000	2001
Tillage systems								
1. Tillage	73.8	76.8	33.1	36.3	54.4	43.8	18.0	17.8
2. No-tillage	67.9	67.8	28.5	31.6	47.7	33.9	18.1	17.7
F. test 5%	*	*	*	*	*	*	N.S	N.S
Intercropping patterns								
1. Solid.	95.1	96.6	46.0	51.8	75.5	60.0	18.3	18.2
2. Soybean was sown on one side of the ridge and sunflower on the other side and maize in the middle of the ridge among soybean and sunflower.	67.5	67.8	27.7	31.2	45.8	36.2	18.1	17.7
3. Soybean was sown in the middle of the ridge among sunflower and maize.	53.5	53.8	21.7	23.6	39.8	25.6	17.4	17.1
4. Soybean was sown on oneside of the ridge and maize on one the other side in the same ridge and sunflower in the middle of the ridge among maize and soybean.	67.8	67.2	27.9	29.3	43.2	33.6	18.2	18.0
F. test							N.S	N.S
L.S.$D_{0.05}$	4.9	2.8	3.2	3.6	5.8	5.9		

Table 3: Average values of seed yield/plant, seed yield/feddan, seed oil content and seed protein content of soybean plants as affected by tillage systems and intercropping treatments in 2000 and 2001 seasons.

Treatments	Seed yield/plant (g)		Seed yield/feddan (kg)		Seed oil content (%)		Seed protein content (%)	
	2000	2001	2000	2001	2000	2001	2000	2001
Tillage systems								
1. Tillage	8.3	8.5	833.2	836.9	19.1	18.8	40.7	39.8
2. No-tillage	7.8	8.0	733.7	761.4	18.3	20.0	40.0	39.7
F. test 5%	*	*	*	*	*	*	N.S	N.S
Intercropping patterns								
1. Solid.	11.1	10.9	1007.4	1053.2	19.6	21.7	40.2	40.8
2. Soybean was sown on one side of the ridge and sunflower on the other side and maize in the middle of the ridge among soybean and sunflower.	7.4	7.7	632.6	678.3	19.8	17.8	41.0	39.8
3. Soybean was sown in the middle of the ridge among sunflower and maize.	6.5	6.6	569.9	582.6	19.3	20.4	40.6	40.4
4. Soybean was sown on one side of the ridge and maize on the other side in the same ridge and sunflower in the middle of the ridge among maize and soybean.	7.2	7.8	673.9	682.5	18.0	20.3	39.5	38.1
F. test							N.S	N.S
$L.S.D_{0.05}$	0.6	0.6	51.7	38.8	0.8	1.2		

Table 4: Average of plant height, number of pods/plant, number of seeds/plant and 100-seed weight of soybean plants as affected by the interaction between tillage systems and intercropping treatments in 2000 and 2001 seasons.

Tillage system	Intercropping patterns	Plant height (cm)		Number of pods/plant		Number of seeds/plant	
		2000	2001	2000	2001	2000	2001
Tillage	1. Solid	98.2	101.7	51.1	55.5	83.4	68.6
	2. .Soybean was sown on one side of the ridge and sunflower on the other side and maize on the middle of the ridge among soybean and sunflower.	69.5	71.8	29.5	34.7	46.5	40.7
	3. Soybean was sown in the middle of the ridge among sunflower and maize.	56.5	62.5	22.2	24.2	43.5	28.9
	4. Soybean was sown on one side of the ridge and maize on the other side of the same ridge and sunflower in the middle of the ridge among maize and soybean.	71.1	71.3	29.7	31.1	44.2	37.2
Mean		73.8	76.8	33.1	36.3	54.4	43.8
No-tillage	1. Solid	92.0	91.5	41.0	48.1	67.7	51.5
	2. .Soybean was sown on one side of the ridge and sunflower on the other side and maize in the middle of the ridge among soybean and sunflower.	65.6	63.8	25.8	27.7	45.1	31.7
	3. Soybean was sown in the middle of the ridge among sunflower and maize.	51.0	53.1	21.1	23.0	36.1	32.3
	4. Soybean was sown on one side of the ridge and maize on the other side of the same ridge and sunflower in the middle of the rridge among maize and soybean.	62.9	63.1	26.0	27.5	42.2	30.1
Mean		67.9	67.8	28.5	31.6	47.7	33.9
L.S. D. $_{0.05}$		9.3	8.7	7.5	8.3	7.3	7.9

Table 5: Average of seed yield/plant, seed yield/feddan, seed oil content and seed protein content of soybean plants as affected by the interaction between tillage systems and intercropping treatments in 2000 and 2001 seasons.

Tillage system	Intercropping patterns	Seed yield/plant (g)		Seed yield/feddan (kg)	
		2000	2001	2000	2001
Tillage	1. Solid.	11.59	11.28	1352.3	1221.3
	2. Soybean was sown on one side of the ridge and sunflower on the other side and maize on the middle of the ridge among soybean and sunflower.	7.71	7.94	666.2	724.6
	3. Soybean was sown in the middle of the ridge among sunflower and maize.	6.62	6.75	587.9	612.1
	4. Soybean was sown on one side of the ridge and maize on the other side in the same ridge and sunflower in the middle of the ridge among maize and soybean.	7.50	8.14	726.6	689.7
Mean		8.35	8.52	833.2	836.9
No-tillage	1.Solid.	10.76	10.58	1162.5	1185.0
	2.Soybean was sown on one side of the ridge and sunflower on the other side and maize on the middle of the ridge among soybean and sunflower.	7.10	7.55	599.1	632.0
	3.Soybean was sown in the middle of the ridge among sunflower and maize.	6.38	6.61	551.9	553.2
	4.Soybean was sown on one side of the ridge and maize on the other side of the same ridge and sunflower in the middle of the ridge among maize and soybean.	7.06	7.46	621.2	675.3
Mean		7.82	8.05	733.7	761.4
L.S.$_{D0.05}$		N.S	N.	70.3	59.9

Table 6: Average of grain yield/feddan of maize as affected by tillage systems and intercropping treatments in 2000 and 2001 seasons.

Treatments	Grain yield (ardab/feddan)	
	2000	2001
Tillage systems		
1. Tillage	9.70	9.85
2. No-tillage	8.25	9.07
F.test 5%	*	*
Intercropping patterns		
1. Pure stand of maize.	13.80	14.41
2. Maize was sown on one side 1 of the ridge and soybean on the other side and sunflower on the middle of the ridge among maize and soybean.	7.72	8.24
3. Maize was sown in the middle of the ridge among soybean and sunflower.	6.91	7.56
4. Maize was sown on the other side 2 of the ridge and sunflower on one side 1 in the same ridge and soybean in the middle ridge among sunflower and maize.	7.47	7.62
5. F. test	0.64	0.93
L.S.$D_{0.05}$		

Table 7: Averag of grain yield/feddan of maize as affected by interaction between tillage systems and intercropping treatments in 2000 and 2001 seasons.

	Intercropping patterns	Grain yield (ardab/feddan)	
		2000	2001
Tillage	1. Pure stand of maize .	14.98	15.22
	2. Maize was sown on one side of the ridge and soybean on the other side and sunflower on the middle of the ridge among maize and soybean.	8.53	8.95
	3. Maize was sown in the middle of the ridge among soybean and sunflower.	7.36	7.86
	4. Maize was sown on onside of the ridge and sunflower on the other side in the same ridge and soybeano on the middle of the ridge among sunflower and maize.	7.93	7.37
Mean		9.70	9.85
No-tillage	1. Pure stand of maize .	12.62	13.61
	2. Maize was sown on one side of the ridge and soybean on the other side and sunflower on the middle of the ridge among maize and soybean.	6.91	7.54
	3. Maize was sown on the middle of the ridge among soybean and sunflower.	6.46	7.26
	4. Maize was sown on one side of the ridge and sunflower on the other side in the same ridge and soybean in the middle ridge among sunflower and maize.	7.01	7.87
Mean		8.25	9.07
L.S. D. 0.05		0.93	1.05

Table 8: Average values of seed yield/feddan of sunflower as affected by tillage systems and intercropping treatments in 2000 and 2001 seasons.

Treatments	Seed yield (kg/feddan)	
	2000	2001
Tillage systems		
1. Tillage	791.01	700.71
2. No-tillage	602.15	560.62
F.test 5%	43.27	54.79
Intercropping patterns		
1. Pure stand of sunflower.	1080.45	975.02
2. sunflower was sown on one side of the ridge and s Maize on the other side and soybean on the middle of the ridge among sunflower and Maize	571.12	524.28
3. sunflower was sown in the middle of the ridge among maize and soybean.	559.62	499.28
4. sunflower was sown on one side of the ridge and soybean on the other side in the same ridge and maize on the middle ridge among sunflower e and soybean.	575.12	523.57
5. F. test	77.14	92.76
L.S.D$_{0.05}$		

Table 9: Average of seed yield/feddan of sunflower as affected by interaction between tillage systems and intercropping treatments in 2000 and 2001 seasons.

Tillage system	Intercropping treatments	Seed yield (ardab/feddan)	
		2000	2001
Tillage	1. Pure stand of sunflower.	1204.57	1094.03
	2. sunflower was sown on one side 1 of the ridge and s Maize on the other side 2 and soybean in the middle of the ridge among sunflower and Maize	661.01	578.65
	3. sunflower was sown in the middle of the ridge among maize and soybean.	643.52	545.23
	4. sunflower was sown on the other side 2 of the ridge and soybean on one side 1 in the same ridge and Maize in the middle ridge among sunflower e and soybean.	654.93	584.93
Mean		791.01	700.71
No-tillage	1. Pure stand of sunflower.	956.34	856.01
	2. sunflower was sown on one side 1 of the ridge and s Maize on the other side 2 and soybean in the middle of the ridge among sunflower and Maize	481.23	469.92
	3. sunflower was sown in the middle of the ridge among maize and soybean.	475.72	453.34
	4. sunflower was sown on the other side 2 of the ridge and soybean on one side 1 in the same ridge and Maize in the middle ridge among sunflower e and soybean.	495.31	463.21
Mean		602.15	560.62
$L.S.D._{0.05}$		94.13	112.36

It is clear from Tables 8 and 9 that tillage systems gave the highest values compared to no-tillage. The highest sunflower seed yield/fed. was obtained by sowing sunflower on one side of the ridge and conventional tillage. Similar results were reported by Gercia and Pinchinat (1976), Moallem (1979), Mohta and De (1980) and Abd El-Gawad *et al.*(1989),

REFERENCES

Abd El-Gawad, A.A.; A.M. Abo-Shetaia and A.S. Edris (1989a). Intercropping sunflower with soybean. 1. Effect of intercropping sunflower with soybean on growth, yield and yield components of soybean. Ann. Agric. Sci. Cairo Univ., 34 (1): 77-88.

A.O.A.C. (1970). Association of Official Agricultural Chemists. Official Methods of Analysis. 11th Ed. A.O.A.C., Washington, D.C.

Beets, W.C. (1977). Multiple cropping of maize and soybeans under a high level of crop management. The Netherlands J. Agric. Sci., 25 (2): 95-102.

Dhingra, K.K.; M.S. Dhillon; D.S. Grewal and K. Sharma (1991). Performance of maize and mungbean intercropping in different plantings patterns and row orientations. Indian J. Agron., 3b (2): 207-212.

El-Douby, K.A.; K.E. El-Habbak; H.E. Khalil and S.A. Attia (1993). Effect of some intercropping pattern on growth and yield of maize and soybean. Ann. Agric. Sci., Moshtohor, 34 (3): 913-933.

Galal, A.A.; L. Hindi; M.M.F. Abdalla and A.A. Metwally (1980). Soybean and corn yields at different intercropping patterns. Boulder, Colorado, Westview Press, 69: 2-12.

Galal, A.A. and A.A. Metwally (1982). The variability in intercropping tolerance of 18 soybean varieties when grown with a newly developed corn stock. Cairo 1, Research Bull. Fac. Agric., Ain Shams Univ., 21: 2-15.

Garcia, M.J. and A.M. Pinchinat (1976). Intercropping of maize and soybeans at different sowing densities. Turrialba, 26 (4): 409-411.

Moallem, S.R. (1979). Intercropping of maize (*Zea mays* (L.)) and soybean (*Glycine max*) with different plant population, fertilizer level and method of planting under dry land agriculture. J. Agric. Sci., 14: 637.

Mohta, N.K. and R. De (1980). Intercropping maize and sorghum with soybean. J. Agric. Sci. Camb., 95: 117-122.

Moursi, M.A.; A.A. Abdel-Gawad and A.E. Abo-Shetaia (1983). Effect of some intercropping patterns on growth and yield of maize and soybean. Proc. First Conf. Agron., 1-1, Cereal Crops: 112 – 117.

Snedecor, G.W. and W.G. Cochran (1968). Statistical Methods. 6th Edition, Iowa Univ. Press, Ames, Iowa, U.S.A.

Sorenson, P.S. (1947). The analysis of foods. John Wiley and Sons, New York.

Tetio Kagho, F. (1988). Influence of plant density and intercropping on maize and soybean growth, light interception, yield and efficiency indices. Dissertation International, (6) 2003B. (C.F. Field Crop Abst. 5274, 1989)

Tripathi, R.D.; G.P. Srivastava; M.S. Nisra and S.C. Pandey (1971). Protein control in some varieties of legumes. The Allah Abad Farmer, 16: 291-294.

Ujinaiah, U.S.; B.G. Rajashekar; N. Venugopal and K. Seenappa (1991). Sunflower-pigeonpea intercropping. J. of Oil Seeds Res., 8 (1): 72-78. (C.F. Field Crop Abst. 46 (1): 448, 1993)

Varughese, K. and M.R. Iruthayaraj (1996). Response of sole and intercropped maize to irrigation and nitrogen levels. Madras Agric. J., 83 (3): 189-193. (C.F. Field Crop Abst. 7209, 1997)

Weil, R.R. and M.E. McFadden (1991). Fertility and weed stress effects on performance of maize/soybean intercrop. Agron. J., 83 (4): 717-721.

تأثير تحميل الذرة وعباد الشمس على محصول فول الصويا ومكوناته تحت نظم الخدمة فى الأراضى الجديدة

فتحى رجب رمضان نوار

معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – الجيزة

أجريت هذه الدراسة بمحطة البحوث الزراعية بالنوبارية خلال موسمى ٢٠٠٠ و ٢٠٠١ لدراسة تأثير نظم الخدمة (خدمة ، بدون خدمة) وأربع معاملات للتحميل (١- زراعة منفردة وذلك بزراعة فول الصويا على مسافة ١٠ سم على جانبى المصطبة (١٢٠ سم) ونباتين بالجورة وزراعة عباد الشمس والذرة على مسافة ٣٠ سم بين الجور وعلى جانبى المصطبة ونبات واحد/جورة، ٢- زراعة فول الصويا على أحد جانبى المصطبة وزراعة عباد الشمس على الجانب الآخر من الخط وأيضا زراعة الذرة فى منتصف الخط بين فول الصويا والذرة، ٣- زراعة فول الصويا فى منتصف المصطبة بين زراعة الذرة وعباد الشمس، ٤- زراعة فول الصويا على الجانب الآخر من المصطبة وزراعة الذرة على الجانب الأول من الخط وزراعة عباد الشمس فى منتصف الخط بين الذرة وفول الصويا) والتفاعل بينهم على نمو ومحصول فول الصويا فى الأراضى الجديدة. وقد اتبع تنفيذ القطع المنشقة مرة واحدة فى أربع مكررات. وقد أوضحت النتائج الآتى:

١- أثرت نظم الخدمة ومعاملات التحميل معنويا على إرتفاع النبات وعدد القرون/نبات وعدد البذور/نبات ومحصول النبات ومحصول الفدان والنسبة المئوية للزيت . وأعطت الخدمة الكاملة أعلى محصول للبذور/فدان بالمقارنة بتلك بدون خدمة فى كلا الموسمين، وأعطت الزراعة النقية أعلى محصول للبذور عن معاملات التحميل.

٢- أدى التفاعل بين نظم الخدمة ومعاملات التحميل إلى زيادة معنوية فى ارتفاع النبات وعدد القرون وعدد البذور/نبات ومحصول البذور/فدان، وكان أعلى محصول للبذور باستخدام الخدمة الكاملة وزراعة فول الصويا على أحد جانبى المصطبة.

٣- أشارت النتائج إلى أن نظم الخدمة ومعاملات التحميل والتفاعل بينهم أعطى تأثير معنوى فى محصول الحبوب فى الذرة وعباد الشمس وأن الزراعة المنفردة فى الذرة وعباد الشمس أعطت محصول أعلى عن الزراعة المحملة.

ويمكن التوصية من نتائج هذه الدراسة بزراعة فول الصويا على مسافه ١٠ سم على أحد جانبى المصطبة (١٢٠سم) والخف على نباتين مع الخدمة الكاملة تحت ظروف الأراضى الجيرية فى منطقة النوبارية.