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RESPONSE OF SOYBEAN (*Glycine max*, L. Merrill) TO PLANT DISTRIBUTIONS AND MICROELEMENTS FOLIAR SPRAYING :
II. YIELD AND ITS COMPONENTS

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ABSTRACT

Two field experiments were conducted at El-Mehala El-Kobra Center, Gharbia Governorate, Egypt during the two summer seasons of 2000 and 2001. This investigation was aimed to study the effect of plant distribution treatments and microelements foliar spraying on yield and its components as well as simple correlation coefficients of soybean seed yield and its attributes of cv. Giza 35. The experiments were included six plant distributions and seven treatments of microelements foliar application. A strip plot design with four replicates was used. The main findings could be summarized as follows:

The tested plant distribution treatments markedly caused significant differences in all studied yield and its component characters in both seasons. The results showed that sown soybean plants in arrangements that approach uniformity on two sides of the ridge, 10 cm between hills and leaving one plant per hill (D4) produced the highest numbers of pods / plant, seed yield / plant, seed and straw yields (t/fed) in both seasons. The highest averages of 100-seed weight and oil yield (Kg/fed) were produced from sown on two sides of the ridge, 10 or 20 cm between hills and leaving one or two plants per hill, respectively.

Microelements foliar applications clearly showed a significant effect for all studied yield and its component characters in both seasons. The results showed that foliar spraying with the combination of Mn + Mo and /or the combination of Zn + Mo at concentrations of 100 and 50 ppm, respectively significantly produced highest pods number per plant, 100-seed weight, seed yield/ plant, seed and oil yields per feddan. Maximum straw yield per feddan was produced from spraying with the combination of Mn + Mo at concentrations of 100 and 50 ppm, respectively.

The highest seed and oil yields (t/fed) were obtained from the interaction between planting on two sides of the ridge, 10 or 20 cm between hills and leaving one or two plants per hill, respectively with foliar application the combination of Mn + Mo at concentrations of 100 and 50 ppm, respectively in both seasons.

There is a positive and significant correlation among seed yield/ fed and each of leaf area index, number of branches per plant, number of pods per plant, 100-seed weight and seed yield/ plant.

In general, it can be concluded that for maximizing seed and oil yields per unit area of soybean could be achieved by distribution plants in arrangements that approach uniformity by sown on the two ridge sides, 10 or 20 cm between hills and leaving one or two plants per hill with foliar spraying the combination of Mn + Mo or Zn +Mo at concentrations of 100 and 50 ppm, respectively.

INTRODUCTION

Distribution of soybean plants in arrangements that approach uniform distribution may be increase seed yield production through reducing compeition for light and less mutual shading between plants and plants may be produce higher leaf area indexes achieve better light interception and lower competition for light and it could be penetrate deeper into the soybean canopy resulting in increases photosynthesis especially of lower leaves. In this respect, seed yield per unit area were increased due to sown in arrangement that approach uniformity due to increases in pods number per plant, 100-seed weight and seed yield/ plant (Safo-Kantanka and Lawson, 1980 ; Taylor *et al.*, 1982 ; Carangel, 1986 ; Hassan and Abdalla, 1987 ; Samia Hassan and Rabeia, 1987 ; Shahidullah and Hossain, 1987 ; Sharief, 1989 ; Ibrahim, 1996 and Nakano *et al.*, 2001). Oil yield per unit area was increased due to sown on two sides of the ridge, 10 cm between hills, one plant per hill (Samia Hassan and Rabeia, 1987 and Sharief, 1989).

Different foliar application of micronutrients such as Mn, Zn, and Mo are essential to soybean plants especially after building the high dam in Upper Egypt to the soil. Foliar application of microelements on soybean may be improve seed yield and its components. In this respect, Manganese foliar spraying increased seed yield and its components (Sakr *et al.*, 1988 ; Bansal and Nayyar, 1994 ; Singh *et al.*, 1997 and Barge, 2001). A significant yield increases and its components was observed in response to Zn fertilization (Al-Samerria *et al.*, 1988 ; Sakr, 1988 ; Abadi et al., 1995 ; Khamparia, 1996 ; Hugar and Kurdikeri, 2000 ; Anton *et al.*, 2001) and oil yield per unit area (Thalooth *et al.*, 1989 and Hugar and Kurdikeri, 2000). Several workers investigated the effect of molybdenum on yield and its attributes, In this respect, Kalia and Sharma (1988) and Nayak *et al.*, (1989) reported that molybdenum application increased number of pods/ plant, 100-seed weight, seed yield/ plant and oil yield. Similar results were recorded by Wahdan, 1991 ; Hassan *et al.*, 1994 ; Sable *et al.*, 1998 and Anton *et al.*, 2001. The combination of microelement foliar spraying increased seed yield and its attributes (Sakr *et al.*, 1988 ; Chandel *et al.*, 1989 ; Sharief, 1993b ; Sakr and leilah, 1996 ; Hugar and Kurdikeri, 2000 and Anton *et al.*, 2001).

The interaction between plant distributions and molybdenum application significantly affected both seed and its attributes of soybean (Kandil, 1985 and Sharief, 1993a).

The objectives of this investigation were to study the effect of different plant distributions and foliar spraying of different microelements as well as their interaction on seed and oil yields per unit area and yield attributes under the enviromental conditions of Gharbia destrict.

MATERIALS AND METHODS

Two field experiments were conducted at El-Mehalla El-Kobra Center, Gharbia Governorate, Egypt during the two summer seasons of 2000 and 2001. This investigation was aimed to study the effect of different plant distributions and microelements foliar application on seed and oil yields (t/ fed) as well as yield components of soybean (Glycine max, L. Merrill) cv. Giza 35. The field experiments were laid out in a strip – plot design with four replications. The horizontal plots were devoted to the six trearments of plant distributions as follows:

1- Planting on one side of the ridge, 5 cm between hills and leaving one plant in the hill (D1).
2- Planting on one side of the ridge, 10 cm between hills and leaving two plants in the hill (D2).
3- Planting on one side of the ridge, 15 cm between hills and leaving three plants in the hill (D3).
4- Planting on the two sides of the ridge, 10 cm between hills and leaving one plant in the hill (D4).
5- Planting on the two sides of the ridge, 20 cm between hills and leaving two plants in the hill (D5).
6- Planting on the two sides of the ridge, 30 cm between hills and leaving three plants in the hill (D6).

The vertical plots were allocated with the seven treatments of microelements foliar application as follows:

1- Foliar spraying of Mn at concentration of 100 ppm (F1).
2- Foliar spraying of Zn at concentration of 100 ppm (F2).
3- Foliar spraying of Mo at concentration of 50 ppm (F3).
4- Foliar spraying of Mn + Zn at concentrations of 100 ppm of each one (F4).
5- Foliar spraying of Mn + Mo at concentrations of 100 and 50 ppm, respectively (F5).
6- Foliar spraying of Zn + Mo at concentrations of 100 and 50 ppm, respectively (F6).
7- Foliar spraying of Mn + Zn + Mo at concentrations of 100, 100 and 50 ppm, respectively (F7).

Each plot area consisted of five ridges 3.5 meters length and 60 cm in ridges width occupying an area of 10.5 m^2 (1/400 fed). The experimental soil preceded by Egyptian clover (*Trifolium alexandrinum*, L.) in both seasons. Soybean seed of Giza 35 and its suitable peat inoculum Nitrogen were supplied by the Oil Crop Research Section, Agricultural Research Center, Ministry of Agriculture and Land Reclamation, Giza, Egypt. Just before planting, Soybean seeds were inoculated with the peat inoculum Nitrogen by Rhizobium jabonicum, L produced by Sakha Station Research, Egypt. Soybean seeds were hand sown with the usual wet method (Heraty planting) on 10^{th} May and 15^{th} May in 2000 and 2001 seasons, respectively. Three weeks after emergence plants were thinned to the suitable distribution. Phosphorus was added in the form of calcium superphosphate (15.5% P2O5) at the rate of 30 kg P_2O_5/fed. Potassium was added in the form of potassium sulfate (48% K2O) at the rate of 24 kg K2O/fed. Phosphorus and Potassium were incorporated to the soil during seedbed preparation. Nitrogen fertilizer were applied as ammonium nitrate (33.5% N) at the rate of 50 kg/fed on two equal doses (the half of the dose was added before the first irrigation and the other before the second irrigation). Soybean plants were hoed two times, the first was practiced before the second irrigation and the second one was performed before the third irrigation. Foliar spraying of microelements were added after 45 days from planting. Normal agricultural practices as recommended by Ministry Of Agriculture and Land Reclamation were followed.

The soil was clay in texture and pH was 7.9, 8.0. The available manganese was 46.0, 53.0 ppm, the available zinc was 2.6, 3.1 ppm and the available molybdenum was 0.50, 0.54 ppm in the first and second seasons, respectively. The following yield and its components :

1- Number of pods per plant.
2- 100- seed weight (g).
3- seed yield per plant (g).
4- Seed yield in ton/fed was estimated by threshing the harvested plants of the two central ridges of each sub plot and converting the obtained seed yield to seed yield (t/fed) on dry weight basis.
5- Straw yield in ton/ fed was estimated from threshed plants of the two central ridges of each plot and converting the yield in ton/ fed.
6- Oil yield in kg/ fed was calculated using the following formula:
   Oil yield kg/fed = seed yield/fed * seed oil percentage.

Simple correlation coefficients between seed yield/ fed and its components and some other related traits were computed according to Snedecor and Cochran (1980).

An analysis of variance was made in order to test the significance of differences among treatments and their interaction. In order to test the significance among treatments, all obtained data were subjected to the statistical analysis of the strip plot design as described by Gomez and Gomez (1984). Treatments were compared using the least significant difference values (LSD) at 5% and 1% level of probability. Computations were made using computer software.

RESULTS AND DISCUSSION

1- Plant distributions effect:

The results in Tables 1 and 2 clearly showed that plant distribution treatments significantly affected number of pods per plant, 100-seed weight, seed yield per plant and feddan, straw and oil yields per feddan in both seasons. Distribution soybean plants in arrangements that approach uniformity on both ridge sides, 10 or 20 cm between hills and leaving one or two plants per hill (D4 or D5), respectively produced the highest number of pods per plant, heaviest weight of 100-seeds, seed yield per plant and feddan as well as oil yield per feddan.

Highest straw yield per feddan was produced from sown on both ridge sides, 10 cm between hills and leaving one plant per hill (D4) in both seasons compared with other plant distribution treatments. The increases in number of pods/plant, 100-seed weight and seed yield/plant due to sown in arrangements that approach to uniformity i.e. D4 or D5 may be attributed to increases in leaf area and leaf area index (Sharief *et al.*, (2003) and it may attributed to deeper light penetration into the canopy and less mutual shading between plants (Shahidullah and Hossain, 1987 and Ibrahim, 1996) resulting increases in photosynthesis of lower leaves which resulting increases in photosynthetic capacity and hence dry matter accumulation reflected increases in pods number and seed weight and therby seed yield per plant. The increases in seed yield per plant reflected increases in seed yield per unit area and dry matter per unit area i.e. seed and straw yields per feddan. These conclusions are reported by Sharief (1989), Sharief (1993a), Ibrahim (1996), Nakano *et al.* (2001) and Abu El Dahb *et al.* (2002). The increases in oil yield/fed due to more uniform distribution of soybean plants on two ridge sides (D4 or D5) may be due to its increases in seed yield per feddan and oil percentage reflected increases in oil yield per unit area. Similar results were reported by Samia Hassan and Rabeia (1987) and Sharief (1989).

2-Microelements foliar spraying effects:

The results in tables 1 and 2 indicate that microelements foliar application treatments significantly affected number of pods per plant, 100-seed weight, seed yield per plant and feddan, straw and oil yields per feddan in both seasons.

The results clearly showed that maximum values of pods number/plant, weight of 100 seeds, seed yield per plant and feddan as well as oil yield per feddan were produced from foliar application of Mn + Mo at concentrations of 100 and 50 ppm (F_5), or foliar spraying of Zn + Mo at concentrations of 100 and 50 ppm (F_6) and/or foliar spraying of Mn + Zn + Mo at concentrations of 100, 100 and 50 ppm (F_7), respectively. However, The highest seed yields/fed was obtained from foliar spraying of Mn + Mo at concentrations of 100 and 50 ppm (F_5) compared with other foliar spraying treatments in both seasons. The increases in seed yield per feddan due to foliar spraying of Mn, Zn and Mo in double or in combination together may be due to their effects on growth i.e. leaf area, leaf area index and branches number per plant which reflected increases in yield components such as number of pods per plant, 100-seed weight and seed yield per plant which increased seed yield per unit area. Also, the increases in seed yield due to foliar spraying Mn, Zn and Mo may be due to the role of Mo in nitrate reduction and nitrogen fixation in the nodules as well as metabolic processes (Abdel Aziz et al., 1999). These results in great agreement with those reported by Hugar and Kurdikeri (2000), Shelge *et al.* (2000) and Anton *et al.* (2001) The increases in straw yield/fed due to foliar spraying of Mn + Mo may be attributed to its increases in plant height or number of branches per plant and dry matter accumulation which reflected increases in straw yield per unit area. Similar conclusions were reported by Hassanein and Ahmed (1996) and Anton *et al.* (2001). The increases in oil yield/fed due to foliar spraying of microelements may be due to its increases in seed yield per fed and oil percentage which reflected increases in oil yield per unit area. Similar conclusions were obtained by Sharief (1993b), Hugar and Kurdikeri (2000) and Anton *et al.* (2001).

3-Significant interaction effect:

The results graphically illustrated in figures 1 through 4 show the interaction between plant distribution treatments and microelements foliar spraying significantly affected seed yield per feddan and oil yield per feddan in both seasons.

Table 1: Means of number of pods/ plant, 100-seed weight (g) and seed yield/plant as affected by plant distributions and microelements foliar application during 2000 and 2001 seasons.

Characters / Treatments	No. of pods/plant 2000	No. of pods/plant 2001	100-seed weight (g) 20001	100-seed weight (g) 2001	Seed yield/plant 2000	Seed yield/plant 2001
1. Plant distributions						
D1	45.3	47.2	14.27	15.10	15.6	18.2
D2	40.0	41.5	14.08	15.60	14.5	16.7
D3	51.1	53.6	15.09	16.36	16.1	16.3
D4	57.9	61.0	15.58	16.92	19.6	21.8
D5	54.0	57.4	15.50	16.72	18.4	20.7
D6	45.2	47.5	14.46	15.62	16.0	17.9
F. test	**	**	**	**	**	**
LSD 5 %	3.0	3.0	0.60	0.71	1.1	1.3
LSD 1 %	4.1	4.2	0.83	0.99	1.5	1.7
2. Microelements foliar application						
F1	45.9	47.8	14.18	15.31	14.3	16.2
F2	46.0	49.1	14.23	15.37	15.9	17.6
F3	47.5	51.8	14.96	16.11	17.2	18.9
F4	48.4	51.4	14.49	15.53	16.3	17.9
F5	52.6	54.3	15.38	16.73	18.6	20.5
F6	51.6	54.4	15.16	16.35	17.9	19.8
F7	50.5	50.8	15.42	16.97	17.0	19.4
F. test	**	*	**	**	**	**
LSD 5 %	2.0	2.9	0.53	0.61	1.1	1.7
LSD 1 %	2.7	-	0.73	0.81	1.5	2.3

*, ** Denote significant at 0.05 and 0.01 levels of probability, respectively.

The results show that higher seed and oil yields per feddan were obtained from plant distributions of both planting on two sides of the ridge, 10 or 20 cm between hills and leaving one or two plants per hill (D4 or D5) with foliar spraying of Mn + Mo or Zn + Mo at concentrations of 100 and 50 ppm, respectively in both seasons. The increases in seed yield/fed due to sown on both ridge sides (D4 or D5) and foliar spraying of microelements (F5 or F6) may be attributes to more photosynthetic rate due to more light penetrated among canopies (Ibrahim, 1996) and the effect of microelement foliar spraying on leaf area and leaf area index reflected more photosynthetic activity resulting in more dry matter accumulation (Selim, 1992) which reflected increases in seed weight. The increases in oil yield per feddan due to the interaction between plant distribution and foliar spraying of microelements may be due to increases in both oil percentage and seed yield per feddan reflected increases in oil yield per feddan. Similar conclusions were reported by Kandil (1985) and Sharief (1993a).

In general, it could be summarized that for maximizing seed and oil yields per unit area could be achieved by sown soybean on both ridge sides at 10 or 20 cm between hills and leaving one or two plants per hill with foliar spraying of Mn + Mo or Zn + Mo at concentrations of 100 and 50 ppm, respectively under the environmental condition of this study.

Table 2: Means of seed, straw and oil yields per feddan as affected by plant distributions and microelements foliar application during 2000 and 2001 seasons.

Characters	Straw yield (t/fed)		Seed yield (t/fed)		Oil yield (kg/fed)	
Treatments	2000	2001	20001	2001	2000	2001
1. Plant distributions						
D1	1.837	2.069	2.806	3.048	375.4	414.8
D2	1.721	1.931	2.804	3.052	372.3	409.7
D3	2.101	2.379	2.930	3.298	440.7	491.2
D4	2.416	2.739	3.447	3.633	508.6	566.2
D5	2.258	2.524	3.118	3.317	475.3	524.6
D6	1.865	2.101	3.161	3.392	384.2	429.5
F. test	**	**	**	**	**	**
LSD 5 %	0.252	0.288	0.153	0.210	53.0	58.6
LSD 1 %	0.350	0.399	0.212	0.291	73.3	81.1
2. Microelements foliar application						
F1	1.855	2.038	2.600	2.690	377.3	409.0
F2	1.880	2.106	2.601	2.758	391.6	429.6
F3	2.106	2.376	3.000	3.269	443.5	493.3
F4	1.901	2.134	2.864	3.063	396.9	440.6
F5	2.257	2.549	3.596	3.884	472.7	524.4
F6	2.164	2.443	3.301	3.576	452.9	505.8
F7	2.067	2.386	3.347	3.791	447.8	506.0
F. test	**	**	**	**	**	**
LSD 5 %	0.153	0.181	0.089	0.119	33.4	39.9
LSD 1 %	0.210	0.249	0.122	0.164	45.8	54.7

*, ** Denote significant at 0.05 and 0.01 levels of probability, respectively.

Fig 1: Means of seed yield (t/fed) as affected by the interaction between plant distributions and microelements foliar application in 2000 season.

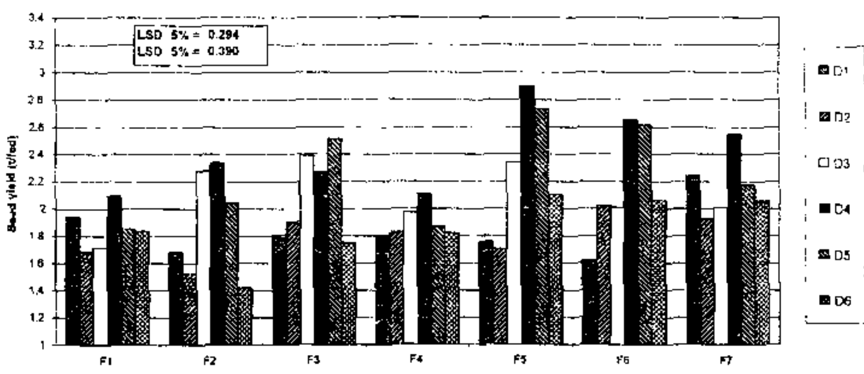
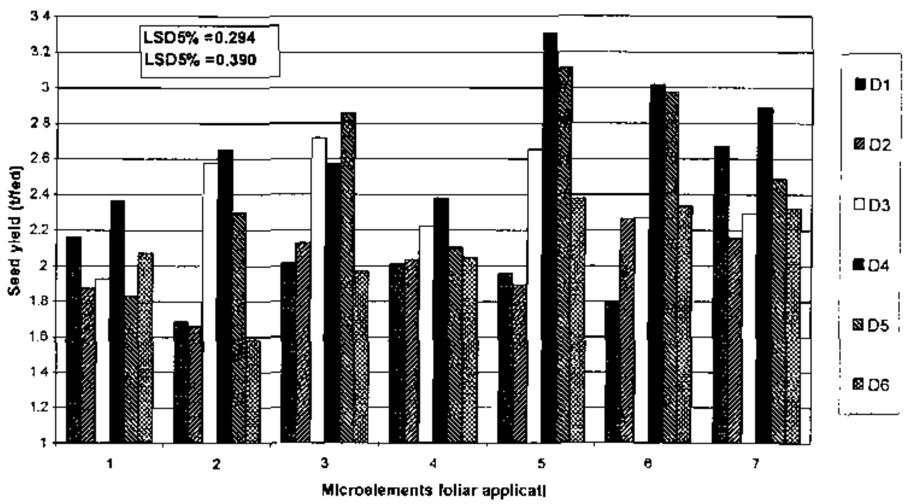


Fig 2: Means of seed yield (t/fed) as affected by the interaction between distributions and microelements foliar applicati[illegible] season.



4-Simple correlation interrelationship between seed yield (t/fed) and its attributes:

The relationship between seed yield in ton/fed and its attributing characters i.e. plant height, leaf area index, number of branches per plant, number of pods per plant, weight of 100-seed (g) and seed yield per plant are presented in Tables 3 and 4 for the two seasons of 2000 and 2001, respectively. The results show that seed yield (t/fed) was positively and significantly associated with leaf area index (0.377 and 0.362), number of branches per plant (0.243 and 0.429), number of pods per plant (0.411 and 0.382), weight of 100-seed (0.277 and 0.282) and seed yield/plant (0.429 and 0.510) in the first and second seasons, respectively. More, seed yield/plant showed significant positive correlation coefficients with leaf area index, number of pods/plant and 100-seed weight in both seasons. Similar results were recorded by Amaranath *et al.* (1990) who reported that seed yield per plant showed significant positive correlation with number of pods and branches per plant as well as 100-seed weight. Meanwhile, 100-seed weight was positively and significantly associated with leaf area index as well as number of pods per plant in both seasons. In addation, number of pods per plant was positively and significantly correlated with leaf area index and number of branches per plant in both seasons.

In general, it could be concluded that seed yield/fad significantly and positively correlated with each of leaf area index, number of branches and pods per plant as well as 100-seed weight and seed yield/plant in both seasons.

Fig 3: Means of oil yield (kg/fed) as affected by the interaction between plant distributions and microelements foliar application in 2000 season.

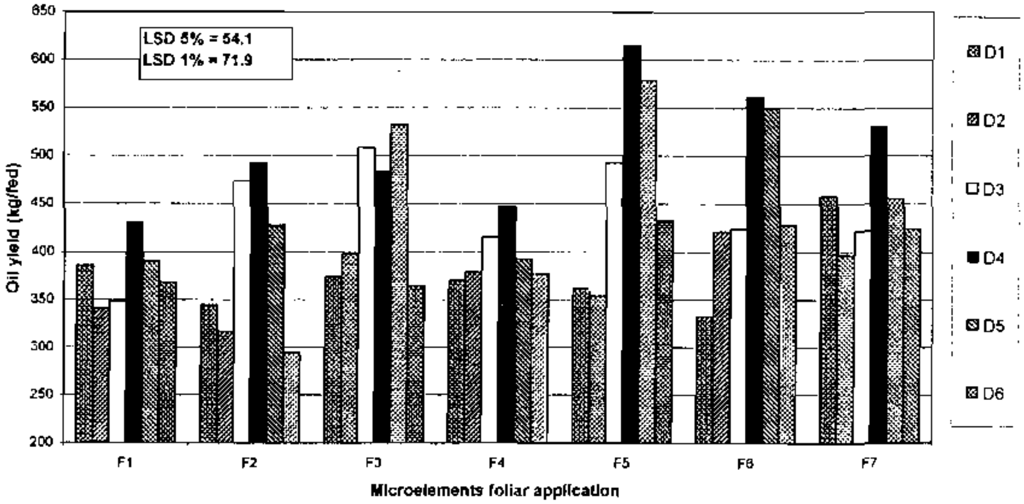


Fig 4: Means of oil yield (kg/fed) as affected by the interaction between plant distributions and microelements foliar application in 2001 season.

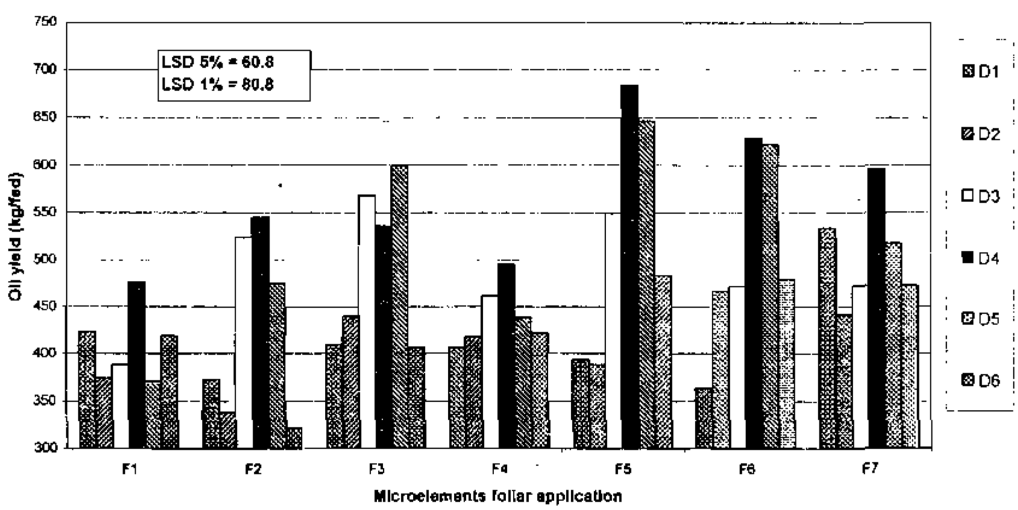


Table 3: Simple correlation coefficients between seed yield/fed and its attributed characters in 2000 season.

Characters	1	2	3	4	5	6	7
1. Plant height	1.000						
2. Leaf area index (LAI)	0.079	1.000					
3. No. of branches / plant	0.243*	0.299**	1.000				
4. No. of pods / plant	0.132	0.373**	0.291**	1.000			
5. 100-seed weight	0.133	0.412**	0.139	0.238*	1.000		
6. Seed yield / plant	0.043	0.300**	0.108	0.222*	0.363**	1.000	
7. Seed yield / fed	0.221*	0.377**	0.243*	0.411**	0.277**	0.429**	1.000

r 5% = 0.195 & r 1% = 0.254

Table 4: Simple correlation coefficients between seed yield/fed and its attributed characters in 2001 season.

Character	1	2	3	4	5	6	7
1. Plant height	1.000						
2. Leaf area index (LAI)	0.105	1.000					
3. No. of branches / plant	0.177	0.535**	1.000				
4. No. of pods / plant	0.057	0.408**	0.349**	1.000			
5. 100-seed weight	0.075	0.435**	0.367**	0.326**	1.000		
6. Seed yield / plant	0.093	0.341**	0.442**	0.314**	0.441**	1.000	
7. Seed yield / fed	0.170	0.362**	0.429**	0.382**	0.282**	0.510**	1.000

r 5% = 0.195 & r 1% = 0.254

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استجابة فول الصويا للتوزيعات النباتية و التسميد الورقى:
٢- المحصول و مكوناته

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أجريت تجربتان حقليتان خلال المواسم الصيفية ٢٠٠٠، ٢٠٠١ بمزرعة خاصة بمركز المحلة الكبرى، محافظة الغربية بهدف دراسة استجابة فول الصويا لستة توزيعات نباتية و سبع معاملات للرش بمحاليل العناصر الصغرى منفردة أو مخاليطها. تم تنفيذ التجارب فى تصميم الشرائح المتعامدة فى أربع مكررات. و يمكن تلخيص اهم النتائج المتحصل عليها فيما يلى:

١- أشارت النتائج الى أن التوزيعات النباتية المختلفة قد أثرت تأثيرا" معنويا" على جميع صفات المحصول و مكوناته المدروسة فى كلا الموسمين الزراعة. حيث أدت الزراعة فى توزيع نباتى الأكثر انتظاما" من خلال الزراعة على الريشتين على مسافة ١٠ أو ٢٠ سم بين الجور مع ترك نبات أو نباتين بالجورة (D4 و D5) على الترتيب للحصول على أعلى زيادة معنوية فى صفات عدد القرون/النبات، وزن المائة بذرة، محصول البذور للنبات و الفدان، محصول القش و الزيت للفدان فى كلا الموسمين.
٢- أوضحت النتائج الى أن معاملات الرش المختلفة بالعناصر الصغرى سواء المنفردة أو مخاليطها أدت الى وجود اختلافات معنوية فى كافة صفات المحصول و مكوناته تحت الدراسة فى كلا الموسمين. أوضحت النتائج تفوق الرش بمخلوط المنجنيز + الموليبدنيم أو الرش بمخلوط الزنك + الموليبدنيم وذلك بتركيز ١٠٠ و ٥٠ جزء فى المليون على الترتيب حيث تم الحصول على أعلى القيم فى صفات عدد القرون/النبات، وزن المائة بذرة، محصول البذور للنبات و الفدان، محصول القش و الزيت للفدان فى كلا الموسمين.
٣- اظهرت النتائج أن للتفاعل بين التوزيعات النباتية و الرش بالعناصر الصغرى تأثير معنوى على كل من محصول البذور و الزيت للفدان فى كلا الموسمين. حيث أوضحت النتائج أن الزراعة على الريشتين على مسافة ١٠ أو ٢٠ سم بين الجور وترك نبات أو نباتين بالجورة و التسميد الورقى بالرش بمخلوط المنجنيز + الموليبدنيم أو الزنك + الموليبدنيم بتركيز ١٠٠ و ٥٠ جزء فى المليون على الترتيب أدى إلى الحصول على أعلى المتوسطات لمحصول البذور و الزيت للفدان فى كلا الموسمين.
٤- أوضحت النتائج أن هناك ارتباط معنوى موجب بين محصول البذور للفدان وكل من دليل مساحة الأوراق، عدد الفروع و القرون بالنبات، وزن المائة بذرة و محصول البذور للنبات فى كلا موسمى الزراعة. وأن محصول البذور للنبات يرتبط ارتباط معنوى موجب مع دليل مساحة الأوراق وعدد الفروع و القرون بالنبات ووزن المائة بذرة فى كلا موسمى الزراعة.

توصى الدراسة للحصول على أعلى محصول من البذور و الزيت من وحدة المساحة يفضل زراعة فول الصويا على الريشتين على مسافة ١٠ أو ٢٠ سم بين الجور مع ترك نبات أو نباتين بالجورة و التسميد الورقى بمخلوط المنجنيز + الموليبدنيم أو بمخلوط الزنك + الموليبدنيم وذلك بتركيز ١٠٠ أو ٥٠ جزء فى المليون على الترتيب وذلك تحت ظروف هذه الدراسة.