J. Agric. Sci. Mansoura Univ., 33 (6): 4397 - 4407, 2008

EFFECT OF SOWING DATE AND PLANT DISTRIBUTION SYSTEM ON GROWTH AND YIELD OF GURMA WATERMELON (*Citrullus lanatus* var. *colocynthoides*)

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ABSTRACT

Two field trials were carried out at Gemmeiza Agric. Res. Station (Gharbia Governorate) during two successive summer seasons of 2005 and 2006 to study the response of gurma watermelon to three sowing date (April 1st, April 15th and may 1st) and three plant distribution system (S_1, one plant/ hill on one side of the ridge, S_2 : two plants/ hill on one side of the ridge and S_3: one plant/ hill on both sides of the ridge) in addition to their interaction on growth, fruit traits and yield. A factorial system in randomized complete blocks design with three replicates was adopted. The results revealed that early planting on April 1st increased the vegetative growth expressed as plant fresh weight ,stem length,number of leaves and number of branches per plant than the other planting dates. However, fruit traits, yield and its as fruits weight, fruit diameter, fruit length, number of fruits per plant, weight of 100 seeds, weight of seeds in fruit and yield (kg/ fed.) were significantly decreased with delaying the sowing date .

Plant distribution system had a significant effect on all studied characters in both seasons, S_1 gave the highest values of plant fresh weight, stem length, number of leaves, number of branches, plant fruit weight, fruit diameter and length, weight of seeds fruit and values of 100 seeds weight, however it had the lowest values of seed yield/ fed. The highest values of seed yield/fed. were obtained by using S_2 system .

The interaction between sowing date and plant distribution system had significant effect on all treats under study in both season. Generally, it could be concluded that, using early planting on April 1st and plant distribution system (S_2: two plants/ hill on one side of the ridge might gave the highest values of seed gurma watermelon yield under similar condition of this work.

INTRODUCTION

Citrullus lamtus var. *colocythoides* has been cultivated since early times in Egypt where its known as gurma watermelon, it is a good for the new reclaimed desert lands, tolerant to drought and salinity. Moreover, the economic importance of gurma watermelon has recently increased because its production exceeds the domestic consumption and hence the country becomes able to export large quantities of gurma watermelon to the Arab countries. However, very little researches have been conducted to evaluate the effect of cultural practices on the growth and seed yield of gurma watermelon.

Sowing date and plant distribution system are considered the most effective factors for plant growth and yield of gurma watermelon.

On plant growth and yield of many cucurbit crops. El-Dweny (1978) mentioned that early sowing date (15 Feb.) of melon varieties resulted in stronger growth and heavier and large size of fruits than those of 15 March and 15 April. In the same line, Ezuddin *et al*., (1989) found that delaying sowing date of snake melon caused a significant decrease in total fruit yield

and average fruit weight. El-Asdoudi (1994) cleared that the number of leaves per plant in watermelon did not differ significantly in plants an 15 April and these of 30 April. Abosedra (1990) on cucumber found that, early planting on April 1st increased vegetative growth than other plant dates. Total yield and its componentis as number of fruits per plant and the average fruit weight were significantly decreased with delaying the date of panting (April 20th and May 10th). Similar results were obtained by Shafshk *et al.* (1990) on squash.

Ragab and El-Asdoudi (1996) found that early sowing date (15 March) significantly increased vegetative growth and yield of melon compared with date 15 April.

Plant population plays an important role in growth and yield of cucurbits plant, while distribution system play a vital role in this field. in this respect , several studies indicted that with increased area per plant (through wide hill spacing , decreasing number of plants/ hill or decreasing row numbers) mean fruit weight increased and fruit size distribution shifted to larger categories, in contrast, fruit number and seed yield per unit area were increased by increasing plant population density (Singh and Naik, 1989; Etman, 1993; Nesmith, 1993; Bracy and Parish, 1997; Motsembocher and Aramcibio, 2002 and Ibrahim, 2005).

The objective of this investigation was to study the effect of sowing date, plant distribution system and their interaction on growth, yield and its components of gurma watermelon.

MATERIALS AND METHODS

This work was carried out at Gemmeiza Agri. Res. Station (Gharbia Governorate) during the two successive seasons of 2005 and 2006 to study the effect of three sowing date , i.e., April 1st , April 15th and May 1st and thee plant distribution system , i.e., S1: one plant /hill on one side of the ridge , S2: two plants /hill on one side of the ridge S3: one plant /hill on both sides of ridge on plant growth, yield and its components of gurma watermelon (Seeds were obtained from Cross Pollinated Vegetable Crops Department, Hort. Res. Institute).

Some physical and chemical properties of the experimental soil at the depth of o-30 cm were determined according to Jakson (1973) Table (1). Besides, maximum, minimum temperature and relative humidity % of Gemmeiza region during the growing seasons of 2005 and 2006 are shown in Table (2).

After emergency (21 day from sowing), seedlings were thinned to S_1, S_2 and S_3 treatments. The factorial system in randomized complete blocks design with three replication was used. The nine combinations of three sowing dates (April 1st (early swing date), April 15th and May 1st (late sowing date)and three plant distribution system were arranged randomly as follow :-

1-April 1st +s_1	2-April 1st + s_2	3-April 1st + s_3
4-April 15th +s_1	5-April 15th +s_2	6- April 15th +s_3
7-May 1st +s_1	8-May 1st + s_2	9- May 1st +s_3

Table (1): Some physical and chemical analysis of experimental soil during 2005 and 2006 seasons.

Measurements	2005	2006
Physical properties		
Sand	23.5	23.2
Silt	24.7	24.8
Clay	51.8	51
Soil type	Clay	Clay
Chemical properties		
pH* values	8.3	8.5
Ec/25o (mm hos/cm)	1.4	1.6
Organic matter %	1.8	1.5
Available nitrogen (ppm)	32	30
Available phosphorus (ppm)	8.8	8.0
Available potassium (ppm)	420	360

- **pH: (1:2.5 soil extract).**

The sub plots were assigned to three plant distribution system:

S_1: one plant / hill on one side of the ridge (5333 plant/ fed.)

S_2: two plants / hill on one side of the ridge (10666 plant/ fed.)

S_3: one plant / hill on both sides of the ridge (10666 plant/ fed.)

The experiments units consisted of 4 ridges each of 5 meters length and 1.5 cm in width, seeds were sown in hills 50 cm apart. The levels of mineral NPK-fertilizers were :150 kg calcium super phosphate /fed.(15.5% P_2O_5)was added during soil preparation, 300kg ammonium sulphate /fed. (20.6 % N) + 100 kg potassium sulphate / fed.(48 % K_2O) .The amount of ammonium and potassium sulphates were devided in two equal parts three weeks and six weeks after sowing, other cultural practices were carried out as commonly practiced and wherever they were needed.

Studied characteristics:

1- Vegetative growth parameters: at 60 days after sowing, a random samples (6 plants) were taken from each treatment to determine plant fresh weight(gm), stem length(cm), number of leaves /plant and number of branches/ plant.

2- Fruit traits: at the harvesting time, a random sample of 10 fruits was taken from each experimental unit to estimate fruit weight, fruit length and diameter(cm).

Yield and its components: Number of fruits /plant, weight of 100 seed, weight of seeds in fruit and seedds yield (kg /fed.).

The all data were statistically analyzed of described by Gomez and Gomez (1984).Treatment means were compared using least significant differences test according the procedure outlined by Snedecor and Cochran (1981)

Table (2): Maximum, minimum temperature and relative humidity of Gemmeiza region during the growing seasons of 2005 and 2006.

Month	2005					2006			
	Dates(mean)	Max. T 0C	Min. T oC	R.H.% 7:30	R.H.% 13:30	Max. T oC	Min. T oC	R.H.% 7:30	R.H.% 13:30
April	1-10	23.1	8.6	77.1	50.3	24.8	83.0	86.0	53.0
	11-20	28.6	12.1	85.1	44.4	28.0	9.8	81.0	46.0
	20-30	27.3	11.5	85.1	43.8	28.4	10.4	82.0	47.0
G. Mean		26.3	10.7	82.4	46.2	27.0	9.5	81.0	47.0
May	1-10	28.3	11.0	76.6	40.7	27.4	10.5	79.4	47.4
	11-20	32.4	13.8	82.0	36.0	28.3	10.4	80.0	47.2
	20-31	30.6	15.2	78.1	43.1	32.5	15.0	86.5	45.0
G. Mean		29.5	13.0	76.4	38.6	28.5	11.6	79.3	45.0
June	1-10	30.8	16.7	80.1	45.0	33.2	16.5	69.4	46.0
	11-20	32.1	18.0	80.4	43.0	29.5	15.4	79.0	46.0
	20-30	31.7	18.4	86.0	53.0	32.7	19.1	86.3	50.0
G. Mean		31.5	17.7	82.2	47.0	63.7	17.0	81.4	47.0
July	1-10	32.5	19.0	88.6	55.3	32.3	18.5	87.0	58.6
	11-20	34.1	19.3	96.9	51.4	32.5	18.6	86.2	60.1
	20-31	33.3	20.7	82.7	56.6	32.2	17.0	90.5	60.4
G. Mean		33.2	19.0	87.7	52.6	31.3	17.5	85.1	58.0

RESULTS AND DISCUSSION

1. Vegetative growth parameters

1.1. : Effect of sowing date:

Data recorded in Table (3) explain that growth parameters of gurma watermelon plants expressed as plant fresh weight, stem length, number of leaves of plant and number of branches/ plant were significantly influenced by sowing date in both seasons. The highest values of these traits were obtained by early planting April 1st compared with medium (April 15th) and late sowing dates (may 1st) in both seasons.

Table (3): Vegetative growth characteristics of gurma watermelon as affected by sowing date during 2005 and 2006 seasons.

Treatments	Plant fresh weight (g)		Stem length (cm)		No. leaves/ plant		No. branches/ plant	
	2005	2006	2005	2006	2005	2006	2005	2006
April 1st	750.78	720.0	228.22	219.44	76.0	74.44	4.32	4.29
April 15th	670.89	667.0	200.0	190.78	64.0	62.78	3.74	3.69
May 1st	574.56	542.0	173.83	167.88	55.0	55.67	2.62	2.71
L.S.D. at 5%	17.79	8.11	4.85	3.58	2.55	2.17	0.158	0.18

These results may be due to the favorable conditions for higher net assimilation rate in early sowing date. Such effect is also due to higher respiration rate due higher temperature Table (2) prevailing during late sowing date resulted in decreasing net assimilation rate and consequently

affecting plant growth. Obtained results are in harmony with those reported by Abo- sedra (1990) on cucumber, Shafshak *et al* .(1990) on squash and Ragab and El-Asdoudi (1996) on melon. Also, Abd El- Mageed *et al*. (2003) on melon found that planting at 5 April gave the highest values of vegetative growth and yield**.**

1.2. Effect of plant distribution system:

Date recorded in Table (4) explain that growth parameters of gurma watermelon plants expressed as plant fresh weight, stem length, number of leaves/ plant and number of branches/ plant were significantly influenced by plant distribution system in both seasons. The highest values of these trails were obtained by S_1 followed S_2 and S_3.

Table (4): Vegetative growth parameters of gurma watermelon as affected by plant distribution system during 2005 and 2006 seasons.

Treatments	Plant fresh weight (g)		Stem length (cm)		No. leaves/ plant		No. branches/ plant	
	2005	2006	2005	2006	2005	2006	2005	2006
S_1	705.56	686.67	209.11	205.67	71.11	70.78	3.99	4.29
S_2	674.00	643.89	201.94	191.00	64.89	64.67	3.66	3.68
S_3	614.00	599.44	191.0	181.00	59.78	57.44	3.16	2.71
L.S.D. at 5%	17.79	8.14	4.85	3.58	2.55	2.17	0.16	0.18

S_1: one plant/ hill on one side of ridge.S_2: two plant/ hill on one side of ridge.S_3: one plant/ hill on both sides of the ridge.

These results might be due to the high population densities and the competition between individual plant for the available nutrients in the surrounding media which affect their growth rate. Similar results were obtained by Ibrahim (2005) on gurma watermelon.

1.3. Effect of interaction between sowing dates and plant distribution system:

The interaction between sawing date and plant distribution system had a significant effects on plant fresh weight, stem length, number of leaves and number of branches/ plant in both season (Table 5).

Data indicate that the highest values of these traits were recorded with April 1st sowing date X S_1. While the lowest values were recorded with late sowing date (May 1st) X S_3 in comparison with other treatments. These pronounced positive effects on the vegetative growth parameters of gurma watermelon plants may be attributed to the fact that plant under S_1 (on plant/hill on one side of the ridge) had a lower competition, therefore, efficient usage of water and nutrients was increased and early sowing date April 1st enhanced vegetative growth parameters. Moreover ,it is difficult in carrying hoeing process under s_3 system.

Table (5): Vegetative growth parameters of gurma watermelon as affected by interaction between sowing date and plant distribution system during 2005 and 2006 seasons.

Treatments	Plant fresh weight (g)		Stem length (cm)		No. leaves/ plant		No. branches/ plant	
	2005	2006	2005	2006	2005	2006	2005	2006
April 1st								
S_1	795.0	758.3	238.3	230.0	82.00	80.00	4.77	5.03
S_2	750.0	711.7	230.3	217.0	75.00	76.00	4.28	4.13
S_3	707.0	691.7	216.0	211.0	71.00	67.00	4.00	3.70
April 15th								
S_1	721.0	711.7	204.0	202.0	71.00	69.00	3.97	4.10
S_2	670.0	660.0	201.0	190.0	64.00	62.00	3.87	3.70
S_3	621.0	630.0	194.0	180.0	60.00	57.00	3.40	3.27
May 1st								
S_1	606.0	590.0	185.0	184.0	59.00	63.00	3.33	3.20
S_2	602.0	560.0	173.8	165.0	55.00	55.00	2.77	2.80
S_3	515.0	476.0	162.0	153.3	49.00	48.00	2.07	2.13
L.S.D. at 5%	30.9	19.5	8.41	6.21	4.42	3.75	0.28	0.31

S_1: one plant/ hill on one side of the ridge.S_2: two plants/ hill on one side of the ridge.S_3: one plant/hill on both sides of the ridge.

2. Fruit characters:

2.1. : Effect of sowing date:

Data in Table (6) indicate that early sowing date had a significant increase in fruit characters, *i.e*., fruit weight, length and diameter in both seasons .

This result may be due to that early sowing date provides a long favorable conditions during the growing seasons for the growth of strong and healthy plants which produced a high average of fruit weight and diameter. These results are in agreement with those obtained by El – Dweny (1978), Ezuddin *et al*. (1989) and Ragab *et al*. (1996).

Table (6): Fruit traits of gurma watermelon as affected by sowing date during 2005 and 2006 seasons.

Treatments	Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)	
	2005	2006	2005	2006	2005	2006
April 1st	737.22	727.778	13.331	12.754	11.190	11.756
April 15th	668.0	662.778	11.667	12.00	11.093	10.478
May 1st	584.0	580.0	11.003	10.44	10.267	9.455
L.S.D. at 5%	14.56	8.06	0.288	0.29	0.09	0.22

2.2. Effect of plant distribution system:

There were significant effects for the plant distribution system on fruit weight, fruit length and diameter in both seasons as shown in Table (7). S_1 and the highest values followed by S_2 and S_3.

Table (7): Fruit trails of gurma watermelon as affected by plant distribution system during 2005 and 2006 seasons.

Treatments	Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)	
	2005	2006	2005	2006	2005	2006
S_1	705.0	701.11	12.67	12.61	10.82	11.33
S_2	665.0	655.55	12.11	11.64	10.73	10.54
S_3	619.0	613.89	11.22	10.94	10.09	9.84
L.S.D. at 5%	14.56	8.06	0.288	0.29	0.09	0.22

S_1: one plant /hill on one side of ridge.S_2: two plant /hill on one side of ridge.S_3: one plant/ hill in both sides of the ridge.

These results may be ascribed to the excessive vegetative growth with the low plant density treatments (Table 3) which normally result in higher photosynthesis rate, and in turn causes desirable fruit characters. These results coincide with those obtained by Singh and Naik (1989), Nesmith (1993), Bracy and Parish (1997), Motsembocker and Aramcibia (2002), Goreta *et al*. (2005) and Ibrahim (2005).

2.3. Effect of interaction between sowing dates and plant distribution system:

As shown in Table (8) all studied traits were significantly affected by the interaction between sowing date and plant distribution system in both seasons.

Table (8): Fruit trails of gurma watermelon as affected between sowig date and plant distribution system during 2005 and 2006 seasons.

Treatments	Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)	
	2005	2006	2005	2006	2005	2006
April 1st						
S_1	770.0	760.0	14.2	13.4	12.7	13.0
S_2	730.0	720.0	13.4	12.7	10.6	11.6
S_3	711.0	730.0	12.3	12.2	10.0	10.7
April 15th						
S_1	715.0	707.0	12.4	13.1	11.7	10.9
S_2	670.0	663.0	11.6	11.6	11.3	10.5
S_3	620.0	618.0	11.0	11.3	10.6	10.0
May 1st						
S_1	630.0	637.0	11.3	11.3	11.2	10.6
S_2	595.0	583.0	11.3	10.7	10.3	9.5
S_3	526.0	520.0	10.3	9.4	9.3	8.8
L.S.D. at 5%	24.9	13.9	0.5	0.5	0.16	0.38

S_1: one plant/ hill on one side of the ridge.S_2: two plants/ hill on one side of the ridge.S_3: one plant/ hill on both sides of the ridge.

The highest values of fruit weight, fruit length and diameter were obtained from early sowing date (April 1st) and one plant/ hill one on side of ridge , while the lowest one resulted from late sowing date (May 1st) X one plant/ hill on the two sides of ridge in comparison with other treatment.

The increases in these traits might be resulted from increased vegetative growth parameters at the some treatment Table (5), which in turn, enhanced photosynthesis assimilation and high temperature and relative humidity (Table 2) cusses decrease vegetative growth in late sowing date (may 1st).

3. Yield and its components:

3.1. : Effect of sowing date:

Results in Table (9) show that delaying sowing date significantly decreased the number of fruits/ plant, weight of 100 seeds, weight of seeds in fruit and yield seeds (kg/fed.), while the highest values were obtained by the first sowing date in the two seasons. These results are in accordance with those reported by El-Asdoudi (1994) and Ragab *et al.* (1996).

Table (9): Yield and its components of gurma watermelon as affected by sowing date during 2005 and 2006.

Treatments	No. fruit/ plant		Weight of 100 seeds (g)		Weight of seeds in fruit (g)		Yield of Seeds(Kg/fed.)	
	2005	2006	2005	2006	2005	2006	2005	2006
April 1st	3.44	3.27	16.44	15.93	31.67	28.22	597.22	610.0
April 15th	2.96	3.11	15.29	14.83	27.13	24.06	584.44	576.6
May 1st	2.44	2.39	13.22	12.29	21.84	19.40	452.22	451.0
L.S.D. at 5%	0.14	0.18	0.35	0.36	0.86	0.77	10.53	7.14

3.2. Effect of plant distribution system:

Data presented in Table (10) show that number of fruits was significantly influenced by plant distribution system in both seasons. These results are in agreement with those obtained by Goreta *et al.* (2005) and Ibrahim (2005).

Concerning the effect at plant distribution system on seed yield(Kg/ fed). Table (10) show that two plants/ hill on one side of the ridge gave the highest values followed by S_3 and S_1 in both seasons.

Table (10): Yield and its components of gurma watermelon as affected by plant distribution system during 2005 and 2006.

Treatments	No. fruit/ plant		Weight of 100 seeds (g)		Weight of seeds in fruit (g)		Yield of Seeds(Kg/fed.)	
	2005	2006	2005	2006	2005	2006	2005	2006
S_1	3.20	3.14	16.28	15.40	29.12	26.07	502.22	495.0
S_2	2.94	2.94	15.39	14.34	26.68	23.94	583.89	585.0
S_3	2.70	2.68	13.69	13.31	24.84	21.67	547.78	558.1
L.S.D. at 5%	0.142	0.176	0.346	0.359	0.86	0.776	10.53	7.14

S_1: one plant/ hill on one side of the ridge.S_2: two plants/ hill on one side of the ridge.S_3: one plant/ hill on both sides of the ridge.

These results might be attributed to the greater number of plants in case S_2 and S_3 and which increased number of fruits and seed yield/ fed.. Similar findings were found by Ibrahim (2005).

3.3. Effect of interaction between sowing dates and plant distribution system:

The results in Table (11) show that the interaction between sowing dates and plant distribution system had significant effect on number of fruit/ plant, weight of 100 seed, weight of seeds in fruit and yield (kg seeds/ fed.) in both seasons.

Data indicate that the highest values of number of fruit/ plant, weight of 100 seed and weight of seeds in fruits were obtained by early sowing date (April 1st) and one plant/ hill on one side of ridge.

The highest values of yield (kg seeds/fed) were recorded by early sowing date (April 1st) and S_2 (two plants/ hill on one side of ridge) in both seasons.

Table (11): Yield and its components of gurma watermelon as affected by interaction between sowing date and plant distribution during 2005 and 2006.

Treatments	No. fruit/ plant		Weight of 100 Seeds (g)		Weight of seeds in fruit (g)		Yield of seeds (Kg/fed.)	
	2005	2006	2005	2006	2005	2006	2005	2006
April 1st								
S_1	3.8	3.7	18.0	16.9	35.0	30.0	586	580
S_2	3.4	3.2	16.6	15.8	31.0	28.7	615	640
S_3	3.1	2.9	15.9	15.1	29.0	26.0	590	610
April 15th								
S_1	3.2	3.3	16.4	15.6	27.8	26.0	570	550
S_2	3.0	3.1	15.8	14.6	27.0	24.2	603	595
S_3	2.7	2.9	13.7	4.3	26.5	22.0	580	585
May 1st								
S_1	2.6	2.4	14.5	13.7	24.5	22.2	350	355
S_2	2.4	2.5	13.8	12.6	22.0	19.0	533	520
S_3	2.3	2.2	11.4	10.6	19.0	17.0	423	479
L.S.D. at 5%	0.245	0.296	0.60	0.62	1.50	1.34	18.2	12.4

S_1: one plant/ hill on one side of the ridge. S_2: two plants / hill on one side of the ridge. S_3: one plant/ hill on two sides of the ridge.

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تـأثير ميعـاد الزراعـه و نظـام توزيـع النباتـات علـى نمـو و محصـول بطـيخ اللـب (الجورمة)

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أقيمت تجربتان حقليتان فى محطة البحوث الزراعية بالجميزة – محافظهة الغربيه خلال الموسمين ٢٠٠٥- ٢٠٠٦ لدراسة تأثير ثلاث مواعيد للزراعة فى أول إبريل – الزراعة فى نصف إبريل و الزراعة فى أول مايو) و ثلاثه نظم لتوزيع النباتات (ن١: نبات واحد فى الجوره على ريشة واحدة و ن٢:و نباتين فى الجورة على ريشه واحدة ن٣: نبات واحد فى الجورة على الريشتين) والتفاعل بينهما . تم توزيع مواعيد الزراعة على القطع الرئيسيه عشوائياً و توزيع نظام توزيع النباتات على القطع الشقيه و استخدمت تجربة عا ملية فى ثلاث مكررات

و يمكن تلخيص النتائج المتحصل عليها فيما يلى:

١- أدى ميعاد الزراعة المبكر فى اول ابريل الحصول على أعلى قيم للنمو الخضرى و صفات الثمار و المحصول.

٢- أوضحت النتائج ان نظام توزيع النباتات اثر معنوياً على جميع الصفات المدروسة فى كلا الموسمين , اعطى النظام ن١ أعلى القيم لكل من الوزن الطازج للنبات – طول الساق- عدد الاوراق و عدد الافرع و وزن الثمرة و طول و قطر الثمرة و عدد الثمار على النبات و وزن ١٠٠ بذرة و وزن البذور و الثمرة و لكن اعطى اقل محصول من البذور للفدان.

٣- أثر التفاعل بين مواعيد الزراعة و نظام توزيع النباتات معنوياً على جميع الصفات المدروسة فى كلا الموسمين – حيث اعطى ميعاد الزراعه فى اول ابريل مع نظام توزيع النباتات ن١ أعلى جميع للصفات المدروسه ما عدا المحصول- حيث كانت أعلى قيم للمحصول من زراعة بطيخ اللب فى ميعاد الزراعة الأول (أول إبريل) مع النظام ن٢ (نباتين فى الجورة على ريشه واحدة)

ولذلك يمكن التوصية بزراعة بطيخ اللب (الجورمة) أول إبريل و زراعة نباتين فى الجورة على ريشه واحدة وذلك للحصول على أعلى محصول تحت الظروف المماثله لهذه الدراسة.