J. Plant Production, Mansoura Univ., Vol. 3 (11): 2711 - 2722, 2012

COWPEA (*Vigna unguiculata* L.) PRODUCTIVITY AS AFFECTED BY COMBINATION EFFECT BETWEEN SOWING DATES AND PLANT POPULATION

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ABSTRACT

Two field experiments were conducted during two growing seasons of 2010 and 2011 at Kaha Horticulture Research Station (Qalubia Governorate) to study the effect of sowing dates and plant populations (density and distribution) on growth, dry seed production potentiality and its quality of cowpea cv. Kaha 1. The treatments consisted of combination between three times of sowing i.e. 1st May, 1st June; 1st July and six plant populations i.e. 20, 13 and10 plants/ m^2, on one side per row, with 50 cm row spacing as well as 28, 20 and14 plants/m^2, on two sides per row, with 70 cm row spacing. The experiment was laid out in split plot design with three replications.

Cowpea sown on 1st May recorded significant higher values of growth parameters i.e. plant height, number of leaves, number of branches, leaf area and dry weight/plant as well as seed yield and its components compared to the sown date of 1st July.

The results showed that high plant density recorded higher values for plant height and low values in the number of leaves, branches and leaf area in addition to the plant dry weight, while the results were just the opposite in the low-density.

The results showed that dry cowpea seed yield increased by increasing plant density, especially with the distribution plants on both sides of the width row. But there was a significant increase in the yield components by low number of plants per unit area.

The results showed that the interaction between sowing dates and plant density was significant for yield and its components and the highest values of dry seed yield resulted from sowing in 1st May with the number of plants, 28 plants per square meter and sowing on both sides of the row width of 70 cm.

INTRODUCTION

Cowpea (*Vigna unguiculata* L.) is considered one of the most vegetable legumes. The pods were harvested either at green pods stage for fresh market or at mature stage for dry seeds he need to provide adequate food for humanity at under climate changes that have occurred in recent years with the decrease area allocated for production was motivated for the study to increase the range of cowpea sowing dates, in addition to the maximum utilization of unit area. Another word, it is therefore, necessary to increase the productivity of available food humanity resources per unit land area and time. Planting date is one of the important cultural practices that results in the greatest differences in growth and yield of grain legumes without involving additional costs such as addition of fertilizers.

Many investigators reported that sowing dates showed obvious influence on cowpea plant growth and yield. On plant growth character Rajput (1994) recorded more significant increases on cowpea plant height, number

of leaves/plant and plant canopy area with differences sowing dates. Ravinder and Singh (1998) from the experiment on cowpea using different sowing dates concluded that the plant height, and dry weight per plant were maximum in 23rd June sowing date while most of the growth characters were inferior with late sowing (3rd August). Sani and Negi (1998) indicated that early sowing was preferable for obtaining better growth on *Phaseolus vulgaris*. But on cowpea yield, Rajput (1994) observed that sowing on 10th March recorded more significant values on number of pods per plant, seeds per pod, seed yield and harvest index compared to sowing in 18th February and 30th March. Yadav (2003) concluded from the field experiment on cowpea that sowing in the second week of July being at par with last week of June, produced significant higher grain yield than delayed sowing in last week of July. Patel *et al*., (2005) conducted the experiment in loamy sandy soil with cowpea which revealed that sowing in 2nd March recorded significantly higher seed and haulm yield compared to sowing in 15th February, 17th and 2nd April.

On the other hand, research related on plant density indicated several varied results. Gill *et al*., (1977) reported that, the growth parameters of cowpea such as plant height, lateral branches and trifoliate leaves increased with increasing spacing from 20 cm (110.3 cm plant height, 14.3 lateral branches and 32 trifoliate leaves), 30 cm (116.4 cm plant height, 16.3 lateral branches and 35 trifoliate leaves) to 45 cm (122.8 cm plant height, 18.4 lateral branches and 39 trifoliate leaves). Subramanian *et al*., (1977) conducted experiment on clay loam soil in Coimbatore and indicated that, in cowpea closer spacing (60 x15 cm) the plant height and number of branches/plant were increased comparing to the other spaces (60 x 20 cm and 60 x 25 cm). In cowpea, Arora *et al*., (1971) found that there was slight increase in grain yield with 30 cm row spacing compared to 20 cm. Performance of 40 cm row spacing was the intermediate of two. Mc Ewen (1973) reported that there was a slight increase in number of pods per stem and grain yield with closer spacing (13 cm) compared to wider spacing (51 cm) in field bean. Subramanian *et al*., (1977) revealed that the closer spacing of 60 x 15 cm recorded the highest grain yield (2099 kg ha^{-1}) of cowpea and was superior than the other spaces *viz*., 60 x 20 cm and 60 x 25 cm. Bhat (1981) observed that the grain yield of cowpea increased with increase in row spacing from 30 to 45 cm and further increase in row spacing to 60 cm decreased the grain yield compared to 45 cm. Kwapata and Hall (1990) revealed that seed yield of some bush-type cowpea cultivars can be substantially increased in intensive commercial production by increasing plant density.

Gurusharan and Sharma (2004) obtained significant interaction from planting date and row spacing with bold seeded mungbean planted on March 11, at 20 cm row spacing for grain yield per ha over early or late sowing.

Therefore the objective of this study was to determine the best sowing date as well as optimum stand plant density and row spacing for maximum cowpea production.

MATERIALS AND METHODS

Two field experiments were carried out at Kaha Horticulture Research Station (Qalubia Governorate) during two successive seasons of 2010 and 2011 to study the effect of three sowing dates and six plant populations (density and distribution) treatments on Kaha 1 cowpea (*Vigna unguiculata*, L.) cultivar plant growth, yield and it's components as well as some seeds chemical content.

The objective of this study is to reach for the best planting time limit and the best plant population i, e, plant density and distribution to given the highest yield. Thus, this study is in concern with the following two main topics,

1- Sowing dates treatments

1st May, 1st Jun and 1st July

2-Plant population treatments

With the observation that, there are two models of row width i.e., 50 and 70 cm. row to row concluding the following:

1- 20 plants/m^2: One plant/hill at 10 cm apart on one side per row width of 50 cm.
2- 13 plants/m^2: One plant/hill at 15cm apart on one side per row width of 50 cm.
3- 10 plants/m^2: One plant/hill at 20cm apart on one side per row width of 50 cm.
4- 28 plants/m^2: One plant/hill at 10 cm apart on two sides per rows width of 70cm.
5- 20 plants/m^2: One plant/hill at 15 cm apart on two sides per rows width of 70cm.
6- 14 plants/m^2: One plant/hill at 20 cm apart on two sides per rows width of 70cm.

A split plot design with three replicates was adapted where sowing dates were arranged in the main plots, while the plant population levels were assigned in the sub-plots. The experimental unit area was 14 m^2, 3.5 m width (contains 7 ridges with50 cm row spacing or 5 ridges with70 cm row spacing) and 3 m length. The normal agriculture practices of cowpea production under the condition of this region were followed according to the recommendations of Egyptians Ministry of Agriculture.

The local meteorological data during 2010 and 2011 prevailing at Kaha region were given in Table1

Table 1: Average of some meteorological data at Kaha (Qalubia Governorate) region.

month	2010 Degree of temp.			2011 Degree of temp.		
	max	min	RH%	max	min	RH%
May	31.39	19.68	44.90	27.2	15.5	62.5
Jun	34.67	23.17	47.23	29.3	18.0	66.5
July	34.36	23.45	56.94	31.9	20.4	68.5
August	36.07	25.13	58.94	31.4	19.9	67.5
September	33.23	22.67	55.87	29.6	18.3	65.0
October	31.36	21.03	53.87	28.5	18.0	64.2

Data recorded:

A- Vegetative growth characters:

Five plants were taken random from each plot at 60 days after sowing (pod setting stage) to evaluate the following vegetative characters i.e., plant height (cm), number of leaves per plant, plant leaves area (cm^2) by leaf area meter and dry weights of plant foliage (g)as well as flowering dates.

B- Yield and its components:

At full mature stage five plants from each plot were randomly chosen to determine: number of pods per plant, number of seed per pod, and seed index (mean weight of 100 seed gm).

Shell out % of dry pod was calculated using the following equation:

$$\text{Shell out \%} = \frac{\text{Weight of dry seeds}}{\text{Weight of dry pods}} \times 100$$

Dry pods of all plants per plot were harvested and thrashed manually and total dry yield (kg)/plot were determined

C- Photosynthetic pigments:

Total chlorophyll measured at flowering stage in fresh leaves was determined by using Minolta Chlorophyll Meter SPAD- 501 as SPDA units (Monje and Bugbee, 1992)

D- Chemical composition in seeds (NPK and total protein):

The fine powder (0.2 g) of dry seeds sample was digested in a mixture of Sulphuric and Perchloric acids according to Piper (1947) to estimate total nitrogen in seeds. Total nitrogen (%) was determined by using the modified "Micro-Kheldahl" method apparatus of Parnas and Wagner as described by Pergl (1945). Total protein % was calculated in seeds by multiplying nitrogen (%) content in 6.25.

Statistical study: All data were subjected to the statistical analysis of variance and treatment means were compared according to the Least Significant Differences ($LSD_{0.05}$) test method as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

A. Plant growth:

A.1. Effect of sowing dates

Results in Tables 2 and 3 reveal differences for some plant growth characters i.e. plant height, number of plant leaves, branches and leaf area as well as dry weight in both 1st and 2nd seasons. But this difference was not significant expect number of leaves per plant and leaf area in 2nd season. Various sowing dates in 2nd seasons significantly affected on number of leaves and leaf area. These results might be attributed to the effect of temperature, humidity and light during the growth seasons. Data in Table 1 show the difference in temperature between the 1st and 2nd season and these explain results the differences between of the different seasons. These findings are in harmony with Amer *et al*., (2002) and Amer (2004).

Data in Table 3 showed that sowing dates were significantly affected on flowering dates (50 percent flowering). However, the 50 percent flowering was early in 1st May sowing (48.59 days) followed by 1st June and 1st July sowing dates (51.06 and51.45 days, respectively).

A.2. Effect of plant populations

Results in Table 2 reveal significant differences for most growth characters in both 1st and 2nd seasons. Various plant populations significantly affected on plant growth parameters. The distribution of distance between plants plays a major role in the size and shape of growth. Distribution of plants on both sides of the row gives the best possibility for growth. The results showed obvious increase in the height of plants to increase with increasing plant density and this is due to competition for light. The data showed an increase in the number of branches and number of leaves as well as leaf area and this is due to decreasing plant density and also to the addition of the distribution of plants on both sides of the row most wider. On the other hand data show that reduction in dry weight per plant by increased plant density. Generally, increasing the plant population increased competition among plants for soil moisture, nutrient, light and carbon dioxide. Moreover, the low population plants grew as isolated units for most of their early life and interfered less with each other than at higher densities.

Plant populations significantly influenced on flowering dates. Significant earlier date of flowering was noticed in 20 plants/m^2, one plant/hill at 10 cm apart on one side per row with 50 cm row to row spacing.

These results agree with those reported by Gill *et al*. (1977), Subramanian *et al*. (1977) and Abu baker (2008).

A.3. Interaction effect

Results in Table 2 show the effect of interaction between sowing dates and plant populations on growth characters. The first sowing date (1st May) recorded higher values for the growth parameters than other sowing dates treatments under low plant density. On the other hand the lower plant densities under later sowing dates gave lower values of growth characters.

These results was agree with those obtained by Gurusharan and Sharma (2004) and Krishna 2006.

B- Photosynthetic pigments (Total chlorophyll)

B.1.Effect of sowing dates

Results in Table 3 reveal significant differences for total chlorophyll in 2nd season. Various sowing dates significantly affected total chlorophyll in the leaves of cowpea plants. Sowing on 1st May recorded the highest values of total chlorophyll in 2nd season only. Considering Tables 1and 3, it can noticed that the high temperature have a negative impact on chlorophyll, there is a correlation between high temperature and the composition of chlorophyll.

B.2.Effect of plant populations

Data in Table 3 show the variations among all tested plant populations on total chlorophyll. The plant density of 14 plants/m^2 i.e., one plant/hill at 20 cm apart on two sides per row with 70 cm row spacing recorded significant higher values of total chlorophyll.

Table 2: Effect of sowing dates and plant populations on some cowpea growth characters

Treatments		Plant height (cm)		No. of branches/plant		No. of leaves/plant		Leaf area (cm^2)	
Sow-ing dates	Plant /m^2 (Plant populations)	2010	2011	2010	2011	2010	2011	2010	2011
1st May	20(one side/row 50cm)	37.00	34.03	5.00	4.97	34.00	25.33	60.17	62.02
	13 (one side/row 50cm)	36.67	30.93	4.97	4.90	30.00	29.33	57.94	60.05
	10 (one side/row 50cm)	30.00	30.80	6.07	5.87	44.67	39.67	70.41	67.90
	28 (two sides/row 70cm)	42.00	38.33	5.00	4.63	46.33	27.00	72.21	71.08
	20 (two sides/row 70cm)	42.33	39.87	5.90	4.67	48.67	31.00	67.44	68.46
	14 (two sides/row 70cm)	39.67	30.57	6.20	5.27	48.33	31.67	83.22	75.19
Mean		37.94	34.09	5.52	5.05	42.00	30.67	68.56	67.45
1st June	20 (one side/row 50cm)	33.33	36.57	4.70	4.17	29.67	27.33	67.86	69.26
	13 (one side/row 50cm)	30.33	35.40	5.00	5.07	34.67	28.00	69.38	75.26
	10 (one side/row 50cm)	29.33	30.90	6.20	5.23	39.33	30.00	63.10	62.69
	28 (two sides/row 70cm)	37.67	36.50	5.00	4.67	41.00	30.67	42.67	46.79
	20 (two sides/row 70cm)	35.67	33.63	5.67	4.50	42.00	34.00	65.93	62.08
	14 (two sides/row 70cm)	35.33	33.43	6.10	5.30	40.33	34.33	69.61	67.62
Mean		33.61	34.41	5.44	4.82	37.83	30.72	63.09	63.95
1st July	20 (one side/row 50cm)	32.23	34.17	5.27	4.30	27.67	25.67	54.23	53.18
	13 (one side/row 50cm)	31.83	32.13	5.53	4.37	28.33	30.33	61.15	60.12
	10 (one side/row 50cm)	31.80	33.23	5.53	5.33	27.00	32.67	68.71	69.47
	28 (two sides/row 70cm)	36.33	36.70	4.73	4.93	33.67	32.00	58.15	60.14
	20 (two sides/row 70cm)	36.47	35.97	5.03	4.90	34.00	32.00	60.81	61.02
	14 (two sides/row 70cm)	35.90	35.37	5.60	5.27	40.00	34.00	64.78	64.88
Mean		34.09	34.59	5.28	4.85	31.78	31.11	61.31	61.47
	20 (one side/row 50cm)	34.18	34.93	4.99	4.48	30.66	26.11	60.75	61.49
	13 (one side/row 50cm)	32.94	32.82	5.17	4.78	31.00	29.22	62.83	65.14
	10 (one side/row 50cm)	30.38	31.64	5.93	5.48	37.00	34.11	67.41	66.68
	28 (two sides/row 70cm)	38.67	37.18	4.91	4.74	40.33	29.89	57.68	59.34
	20 (two sides/row 70cm)	38.16	36.66	5.53	4.69	41.56	32.33	64.73	63.85
	14 (two sides/row 70cm)	37.63	33.12	5.97	5.28	42.89	33.33	72.54	69.23
$LSD_{0.05}$	A	N.S	N.S	N.S	N.S	5.65	N.S	N.S	2.31
	B	3.47	2.67	0.73	0.36	3.49	1.94	5.51	4.20
	A×B	N.S	4.63	N.S	N.S	6.04	3.36	9.54	7.28

B.3.Interaction effect

Data tabulated in Table 3 show that the highest values of total chlorophyll of the cultivation of 14 plants / m 2 and sown in 1st July on the two sides of the row width 70 cm row to row.

Table 3: Effect of sowing dates and plant populations on cowpea plant dry weight, total chlorophyll and flowering dates.

Treatments		Dry weight/plant (g)		Total chlorophyll		Flowering dates	
Sowing dates	**Plant /m^2 (Plant populations)**	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**
1st May	20 (one side/row 50cm)	25.20	26.37	593.05	631.25	47.33	45.67
	13 (one side/row 50cm)	35.63	33.27	656.32	611.83	49.00	49.67
	10 (one side/row 50cm)	50.20	34.63	668.99	657.80	49.67	48.00
	28 (two sides/row 70cm)	38.50	40.07	627.87	600.36	48.00	48.67
	20 (two sides/row 70cm)	42.60	42.07	682.05	643.43	47.67	49.00
	14 (two sides/row 70cm)	44.03	42.50	709.73	674.13	51.67	48.67
Mean		39.36	36.49	656.33	636.47	48.89	48.28
1st June	20 (one side/row 50cm)	19.80	24.17	610.06	657.55	49.00	51.33
	13 (one side/row 50cm)	27.73	26.47	688.46	628.25	48.00	52.00
	10 (one side/row 50cm)	33.80	37.53	669.30	621.25	50.00	50.00
	28 (two sides/row 70cm)	23.37	35.27	654.47	615.93	50.00	52.00
	20 (two sides/row 70cm)	33.47	36.33	676.12	591.47	54.00	51.00
	14 (two sides/row 70cm)	33.77	37.87	687.93	636.15	54.00	50.67
Mean		28.63	32.94	664.39	625.06	50.83	51.28
1st July	20 (one side/row 50cm)	27.97	25.63	597.82	546.94	49.33	50.67
	13 (one side/row 50cm)	24.93	28.47	597.44	533.34	51.33	54.00
	10 (one side/row 50cm)	30.13	29.63	736.47	590.70	52.67	51.33
	28 (two sides/row 70cm)	23.77	24.97	669.63	569.70	52.00	50.00
	20 (two sides/row 70cm)	20.13	28.90	672.67	572.53	49.33	51.33
	14 (two sides/row 70cm)	26.67	34.17	689.00	616.79	53.33	52.00
Mean		25.60	28.63	660.51	571.66	51.33	51.56
	20 (one side/row 50cm)	26.32	25.39	600.31	611.91	48.56	49.22
	13 (one side/row 50cm)	29.43	33.44	647.41	591.06	49.44	52.11
	10 (one side/row 50cm)	36.02	33.93	691.25	623.25	50.78	49.78
	28 (two sides/row 70cm)	28.54	33.10	650.66	604.33	50.00	50.22
	20 (two sides/row 70cm)	32.07	36.78	676.94	602.47	50.33	50.44
	14 (two sides/row 70cm)	34.82	37.51	695.55	642.35	53.00	50.44
LSD 5%	A	6.28	0.78	N.S	51.51	1.34	1.33
	B	6.19	4.11	39.23	N.S	1.17	1.40
	A×B	10.72	7.13	67.95	N.S	2.03	N.S

C. Yield and its components

C.1. Effect of sowing dates

Results in Tables 4 and 5 showed that the effects of sowing dates did not endue any significant values on all yield components i.e. number of pods per plant, number of seed per pod and weight of 100 seeds on 1st as well as shelling presenting, except for weight of 100 seeds. However, the latest sowing date (1st July) in the second seasons was recorded lower weight of 100seeds compared with other sowing dates. But the results in Table 5 indicated that dry seed yield was significantly affected by sowing dates. The highest dry seed yield was obtained by sowing on 1st May followed by sowing on 1st June. But 1st July sowing date yielded lower dry seed yield. It could be concluded that the optimal sowing date in this study was on May 1st and any delay or advancement in sowing date caused reductions in cowpea seed yield especially when sown on July 1st. This is due to the influence of weather conditions on growth and flowering, pod setting and yield; and this is clear from consideration of Table 1

These results agree with those reported by Rajput (1994), Yadav (2003), Amer (2004) and Patel *et al*. (2005).

C.2. Effect of plant populations

Data in Tables 4 and 5 show the variations among all plant populations i.e. plant density and distribution treatments for dry cowpea seed yield and its components.

Table 4: Effect of sowing dates and plant populations on some cowpeas yield, component.

Treatments		No. Of pods/plant		No. of seeds/pod		Weight of 100 seeds (g)	
Sowing dates	Plant /m^2 (Plant populations)	2010	2011	2010	2011	2010	2011
1st May	20 (one side/row 50cm)	20.97	19.57	9.13	9.50	17.73	18.43
	13 (one side/row 50cm)	24.73	25.10	8.93	8.97	19.87	19.20
	10 (one side/row 50cm)	26.57	26.63	8.77	9.30	19.17	19.67
	28 (two sides/row 70cm)	22.10	22.43	7.87	8.83	18.33	19.03
	20 (two sides/row 70cm)	25.17	25.43	9.50	9.47	18.97	19.30
	14 (two sides/row 70cm)	26.50	26.17	10.30	10.00	20.73	20.40
Mean		24.34	24.22	9.08	9.34	19.13	19.34
1st June	20 (one side/row 50cm)	23.63	20.27	8.57	9.10	18.10	18.83
	13 (one side/row 50cm)	24.70	26.00	9.77	9.33	19.43	19.50
	10 (one side/row 50cm)	26.00	26.20	9.77	9.43	18.90	19.00
	28 (two sides/row 70cm)	24.03	21.00	8.60	8.63	18.63	19.77
	20 (two sides/row 70cm)	25.80	25.80	9.33	9.57	19.13	20.70
	14 (two sides/row 70cm)	25.80	26.50	10.37	10.07	18.50	20.83
Mean		24.99	24.29	9.40	9.36	18.78	19.77
1st July	20 (one side/row 50cm)	25.67	19.53	8.63	8.70	19.73	19.30
	13 (one side/row 50cm)	24.53	25.93	9.37	9.07	19.63	16.57
	10 (one side/row 50cm)	25.50	26.07	11.00	10.33	20.63	17.70
	28 (two sides/row 70cm)	22.57	21.53	8.33	9.20	17.77	18.97
	20 (two sides/row 70cm)	24.27	24.10	9.37	9.67	18.20	19.20
	14 (two sides/row 70cm)	25.67	25.33	10.83	10.10	19.13	19.43
Mean		24.37	23.75	9.59	9.51	19.18	18.53
	20 (one side/row 50cm)	22.66	19.79	8.78	9.10	18.52	18.86
	13 (one side/row 50cm)	24.66	25.68	9.36	9.12	19.64	18.42
	10 (one side/row 50cm)	26.02	26.23	9.84	9.69	19.57	18.79
	28 (two sides/row 70cm)	22.09	21.65	8.27	8.89	18.24	19.26
	20 (two sides/row 70cm)	25.08	25.11	9.40	9.57	18.77	19.73
	14 (two sides/row 70cm)	26.00	26.00	10.50	10.06	19.46	20.22
LSD 5%	A	N.S	N.S	N.S	N.S	N.S	0.55
	B	0.82	0.75	0.62	0.32	0.82	073
	A×B	1.42	N.S	N.S	0.56	1.42	1.26

Dry seed yield (Ton / fed.) of 28 plants/m2 i.e. One plant/hill at 10 cm apart on the two sides per row (70cm) out yielded of other tested plant populations. On the other words, increasing plant density with distribution on both sides of row revealed to significant increasing of cowpea dry seed yield.

Meanwhile the results show a significant effect of plant density and distribution on yield components. Data showed that the number of plants, at least in the unit area, which distributed the plants at both sides of the row was the highest values in number of pods /plant and the number of seeds /pod as well as the average weight of 100 seed. The results show that the regular

distribution of the largest number of plants per unit area is given the plants a chance to irregular growth and low impact of competition and leading for increasing dry seed yield per unit area.

These finding are in harmony with those of Arora *et al*., (1971), Subramanian *et al*., (1977), Bhat (1981) and Kwapata and Hall (1990).

Table (5): Effect of sowing dates and plant populations on cowpeas seed yield, shelling percentage, and protein %.

Treatments		seed yield (ton/fed.)		shelling percentage		protein %	
Sowing dates	Plant /m^2 (Plant populations)	2010	2011	2010	2011	2010	2011
1st May	20 (one side/row 50cm)	1.18	1.15	70.65	68.62	19.03	17.97
	13 (one side/row 50cm)	0.93	0.88	73.91	73.40	19.47	19.20
	10 (one side/row 50cm)	0.79	0.80	70.03	69.84	21.57	20.63
	28 (two sides/row 70cm)	1.97	2.03	69.50	70.86	18.60	19.00
	20 (two sides/row 70cm)	1.91	1.87	72.87	73.15	20.33	21.20
	14 (two sides/row 70cm)	1.86	1.80	72.27	71.99	22.17	22.13
Mean		1.44	1.42	71.54	71.31	20.19	20.02
1st June	20 (one side/row 50cm)	1.09	0.96	72.93	73.55	18.30	19.10
	13 (one side/row 50cm)	0.94	0.85	74.17	70.54	20.00	19.33
	10 (one side/row 50cm)	0.83	0.79	70.43	68.56	21.00	21.03
	28 (two sides/row 70cm)	1.90	1.86	72.09	68.90	20.03	19.13
	20 (two sides/row 70cm)	1.90	1.68	71.91	70.93	22.13	21.37
	14 (two sides/row 70cm)	1.90	1.69	72.47	71.68	22.07	20.67
Mean		1.43	1.30	72.33	70.69	20.59	20.11
1st July	20 (one side/row 50cm)	0.93	0.92	74.30	74.54	18.50	18.20
	13 (one side/row 50cm)	0.87	0.80	72.25	71.11	20.03	19.17
	10 (one side/row 50cm)	0.84	0.73	71.92	69.52	20.80	21.53
	28 (two sides/row 70cm)	1.84	1.69	72.45	70.62	19.60	17.70
	20 (two sides/row 70cm)	1.73	1.74	70.51	79.74	19.97	18.53
	14 (two sides/row 70cm)	1.73	1.63	70.47	69.30	20.60	19.73
Mean		1.32	1.25	71.98	72.47	19.93	19.14
	20 (one side/row 50cm)	1.07	1.01	72.63	72.24	18.61	18.42
	13 (one side/row 50cm)	0.91	0.85	73.44	71.68	19.83	19.23
	10 (one side/row 50cm)	0.82	0.74	70.79	69.31	21.12	21.07
	28 (two sides/row 70cm)	1.90	1.86	71.35	70.13	19.41	18.61
	20 (two sides/row 70cm)	1.85	1.76	71.76	74.61	20.81	20.37
	14 (two sides/row 70cm)	1.83	1.71	71.74	70.99	21.64	20.84
LSD 5%	A	0.04	0.07	N.S	N.S	N.S	0.36
	B	0.06	0.06	N.S	N.S	0.48	0.37
	A×B	0.10	0.10	N.S	N.S	0.84	0.64

C.3. Interaction effect

Results in Tables 4 and 5 show the effect of the interaction between cowpea sowing dates and plant populations on dry seed yield and its components. The results showed that the values of the yield was the highest under the treatment number of plants of 28 m ^{2} and sown in 1st May on two sides of row, while the Lowest are the values resulting from the cultivation of 10 plants / m 2 and sown in 1st July on one side of the row. But the high values for number of pods/plant, number of seeds /pod and average weight of 100 seeds were given by the lowest plant density. These results were agreed with those obtained by Krishna 2006.

D. Chemical composition in seeds of cowpea plants (total protein percent):

D.1. Effect of sowing dates

Data in Table 5 show that the effect of sowing dates on protein percent in the seed obtained from different treatments. Sowing dates significantly affected on protein percent on cowpea seeds. Sowing on 1st July recorded the lowest values of protein percent in cowpea seeds.

These results agree with those reported by Santiesteban *et al*. (2002) and Krishna (2006)

D.2.Effect of plant populations

Results in Table 5 reveal significant differences for protein percent in the two seasons. Various plant populations significantly affected protein percent for cowpea plants. The highest values for protein percent were recorded by decreased plant density. And that was in the case of sowing on one side or both sides of the row. These findings are in harmony with those of Krishna (2006).

D.3. Interaction effect:

Results in Table 5 showed the effect of the interaction between sowing dates and plant populations on protein percent. Data showed that the highest percentage of protein in the seeds of cowpea plant density resulted from the least population with sowing in 1st May, followed by sowing with the same density in 1st June. This is due to percentage of nitrogen in plants and their relation to plant density and competition between plants.

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إنتاجية اللوبيا وتأثرها بالتوافق بين ميعاد الزراعة والكثافة النباتية

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أجريت تجربتان حقليتان خلال موسمى ٢٠١٠ و ٢٠١١ في المزرعة البحثية لمعهد بحوث البساتين بقها (محافظة القليوبية) لدراسة تأثير ميعاد الزراعة والكثافة النباتية (عددالنباتات فى وحدة المساحة وتوزيعها) وذلك على نمو ومحصول اللوبيا من البذور الجافة. وكانت المعاملات عبارة عن التفاعل بين ثلاث مواعيد زراعة هى١مايو , ١ يونيو ' ١ يوليو وستة كثافات نباتية هى ٢٠ '١٠ ' ١٣ نبات/ م٢ منزرعة على جانب واحد من الخط بعرض ٥٠ سم و ٢٨ ' ٢٠ ' ١٤ نبات /م٢ موزعة على جانبى الخط بعرض ٧٠ سم

سجلت الزراعة فى اول مايو زيادة معنوية فى قياسات النمو وهى أرتفاع النبات 'عدد الاوراق 'عدد الافرع ' مساحة الورقة والوزن الجاف للنبات بالاضافة الى المحصول ومكوناته وذلك مقارنة بالزراعة فى الاول من يوليو.

كما اوضحت النتائج ان الكثافة النباتية العالية سجلت اعلى القيم فى ارتفاع النبات واقلها فى عدد الافرع والاوراق ومتوسط مساحة الورقة وكذلك الوزن الجاف للنبات وكان ذلك على العكس تماما فى الكثافة النباتية المنخفضة .

وقد اظهرت النتائج زيادة معنوية فى محصول اللوبيا من البذور الجافة بزيادة الكثافة النباتية خاصة عند توزيع النباتات على جانبى خط الزراعة الاوسع نسبيا , وكانت هناك زيادة معنوية فى مكونات المحصول بانخفاض عدد النباتات فى وحدة المساحة

أعطى التفاعل بين مواعيد الزراعة والكثافة النباتية تأثيرا معنويا على المحصول ومكوناته وكانت اعلى القيم للمحصول هى الناتجة عن الزراعة فى اول مايو وعدد النباتات فى وحدة المساحة ٢٨ نبات /م٢ منزرعة على جانبى خط زراعة بعرض ٧٠سم

قام بتحكيم البحث

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