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Effect of Nitrogen and Spacing in Growth, Yield and Quality of Celocia cristata

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ABSTRACT

This study was carried out at the demonstration Farm of the Department of horticulture, College of Agricultural Studies during summer season. Experiment one: nitrogen (as urea)at level of 0,25 and 50kgN/fed fifteen days after transplanting of seedlings. Experiment two: manure added at the rate of 0,150 and 300kgN/fed during land preparation. The results revealed that, application of sources of nitrogen (urea or nitrogen) promoted growth of Celosia cristata .It gave the highest values of growth .addition(50kgN) of urea or 300kg/fed manure gave the best vegetative growth of Celosia cristata compared to 25kgN/fed of urea and 150kgs manure. High doses of both urea and manure delayed flowering in plant C.cristata. Moreover, flowers yield and quality, seed yield and quality were affected positively by addition of nitrogen. Increasing of plant spacing decreased plant height but increased number of branches/plant in the season .However, there were no significant effects on flower initiation of C. cristata. Maximum flowers yield and quality (number of flowers /plant or inflorescences, flower diameter and flower age) of celosia were recorded at spacing of 30and 40cm.Maximum number of seeds germination rate and uniformity of Celosia cristata were recorded at closer spacing (20,30cm).

Keywords: Celosia criststa, nitrogen, spacing, yield and quality

1. Introduction

Annual flowering ornamental plants are those plants which end their life cycle within one growing season.

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They are mainly used in gardens and landscape, especially those which have long flower life, they are considered of low production costs. Recently the demand for ornamental plants has been increased , due to urbanization and change of life Nurseries were being established especially in large area (Khartoum area) [1].

In Sudan research on adopting annual ornamental plants is rare and most of production by gardeners and producers depends on their experience, therefore cultural practices such as planting methods, planting dates, sowing dates , spacing (plant population),and fertilizers are known to have great positive effect in growth , yield and quality of different crops, irrigation as well as, possibility of introducing new types , local seeds production and spreading these types locally , are required to cover the demand of the consumers**.**

2. Materials and Methods

Site of experiment: The study was carried out in the Demonstration Farm of the Department of Horticulture, College of Agricultural Studies, Sudan University of Science and Technology at Shambat area (latitude 150 40N, longitude 22° 32'E and Alt. 376m. A.M.S.L.) in summer and winter seasons 2006-20 11

The plant material: The summer annuals used were Celosia cristata and Zinnia elegant. the F1hybrid seeds of Celosia cristata were imported from Holland.

Experiment one: (Urea 45% N_2): Two doses of nitrogen in turn of urea 25 and 5OkgN/fed in addition to control and three plant spacing (20, 30 and 4Ocrh) were tested. -

Experiment two: Organic fertilizer (manure) (goat's residuals): Two doses of organic manure at the rate of 150 and 300Kg/fed in addition to control and three plant spacing (20, 30 and 40cm) were tested.

Production of seedlings: For the experiments, the seeds of C.cristata were racing in the nursery. River silt mixed with sand (3:1), in plastic trays with dimensions of (35 x 25 x 75 cm) with perforated for good drainage was used. Seedlings were hardened by exposure to direct sunlight and gradual water stress. When they reached the suitable size, they were transplanted in the field at the experimental site.

Vegetative growth:

1. Plant height (cm): Plant height of the randomly selected plants was measured from the soil surface up to the end of terminal leaf, and the average plant height was calculated.

2. Number of branches /plant: The numbers of branches of the same plants were recorded and the average number of branches/plant was recorded.

3. Number of leaves/plant: The total number of leaves of the same plant was counted and the average number of leaves/plant was recorded.

Flowers yield and quality: They were evaluated according to the following parameters:

1. Days to 50% flowering: The number of days from transplanting to 50% flowering for each experimental unit of the same plant was calculated and the average number of days was calculated and expressed as 'days to 50% flowering.

2. Number of flowers or inflorescences/plant: The number of flowers or inflorescences/plant was calculated from ten tagged plants and the average was recorded as number of flowers/plant.

3. Number of flowers/inflorescence: The number of flowers of the same plants was counted and the average number of flowers/inflorescent was recorded,

4. Flower diameter (cm): The diameter of 40 randomly selected flowers was measured and, the average diameter of flower was recorded.

5. Flower age (days): The number of days from flower opening till its dropping of 40 randomly selected flowers was calculated and the average age was recorded.

Seed yield: 1. Number of seeds/ flower or inflorescence: Number of seeds of 40 randomly selected plants or inflorescence from each experimental unit and the average number were recorded. 2. Number of seeds/plant

The seeds harvested from 40 randomly selected plants and separated manually, cleaned and counted and the average number of seeds/plant was calculated.

Seed quality: The seed quality test was carried out in the laboratory of seeds testing of The Seeds Administration of Ministry of Agriculture, Khartoum, Sudan as follows: 1. Weight of thousand seeds (gm.), 2. Germination Percentage (G.%), 3. Germination rate (G.R.), 4. Germination uniformity (G.U.)

3. Results

Plant height (cm): The results showed that, both nitrogen and plant spacing had significant effects in plant height in both seasons. The narrowest spacing gave the tallest plants irrespective of nitrogen. However, the tallest plants were obtained at the narrowest (20cm) spacing and the higher level of nitrogen (Table 1).

Number of branches/plant: As in (Table 1), addition of nitrogen, increasing plant spacing and their interactions gave a significant increase in number of branches in both seasons. However, the highest number of branches was obtained at the wider spacing (40cm). Addition of nitrogen up to 5OKgN showed significant increase in number of branches/plant

Number of leaves /plant: There was a significant increase in number of leaves/plant with increasing nitrogen and spacing especially in the second season (2009/2O10). However there was no significant increase in leaves number with addition of nitrogen except at the narrowest plant spacing (Table 1).

Table 1: Effect of nitrogen (as urea) and plant spacing in vegetative growth (plant height, number of branches/plant and number of leaves/plant) at 50% flowering of celosia, in two summer seasons.

Season	Spacing (cm)	Plant height (cm)				Number of branches/ plant				*Number of leaves /plant*			
		Nitrogen (as urea) kg N/fed)											
		0	25	50	Means	0	25	50	Means	*0*	*25*	*50*	*Means*
First season 2006/2007	20	16.0^{e}	16.5^{f}	21.3^{a}	17.6 a	1.0^{e}	1.4^{c}	11.8^{b}	1.4^{b}	*11.3^{b}*	*14.5^{e}*	*17.0d*	*14.6^{e}*
	30	14.3^{b}	17.5^{d}	19.5^{b}	17.1 a	1.0^{c}	2.8^{a}	2.8^{a}	2.2^{a}	*11.3^{i}*	*17.0^{d}*	*19.8^{d}*	*14.6^{e}*
	40	12.5^{i}	18.5^{c}	19.3^{b}	16.8 a	2.0^{c}	2.5^{a}	3.0^{c}	2.2^{a}	*13.8^{f}*	*20.5^{b}*	*22.0^{a}*	*16.6^{b}*
	Means	14.3^{c}	17.2^{b}	20.0^{a}		1.3^{b}	2.1^{a}	2.3^{a}		*12.7^{c}*	*14.3^{b}*	*19.6^{a}*	
	c.v.	6.6			24.3				*5.1*				
Second season 2009/2010	20	14.5^{f}	18.8^{c}	23.0^{a}	18.8 a	1.0^{e}	2.0^{e}	4.5^{c}	2.8^{b}	*22.5^{h}*	*38.0^{b}*	*60.8^{a}*	*40.7^{a}*
	30	15.3^{e}	19.0^{c}	18.3^{c}	17.5 b	2.0^{f}	4.0^{c}	4.0^{c}	3.0^{d}	*22.0^{h}*	*24.8^{e}*	*30.3^{c}*	*25.7^{b}*
	40	13.0^{h}	16.3^{d}	20.0^{b}	16.6 b	3.8^{e}	5.5^{b}	6.5^{a}	5.3^{a}	*24.0^{f}*	*24.3^{f}*	*28.0^{d}*	*25.5^{b}*
	Means	14.250 c	18.2^{b}	20.5^{a}		2.6^{c}	3.8^{b}	5.0^{a}		*22.8^{c}*	*29.0^{b}*	*39.7^{a}*	
	C.V.	7.9				*24.6*				*9.9*			

Means within the same column with similar letter are not significantly different at (P<O.05) according to Duncan's multiple range test.

Flower yield and quality: Number of days to 50% flowering: In the first season (Fig. 1) results showed that, addition of nitrogen increased days to 5o%flowering irrespective of plant spacing especially at widest spacing (3 0,40cm). In the second season there was no noticeable effect due to the addition of nitrogen.

Number of flowers/plant: Data presented in (Fig. 1) showed that nitrogen in both seasons had no significant effect in number of flowers/plant. Whereas, plant spacing showed significant increase in the number of flowers/plant. The highest values resulted at narrowest plant spacing's and addition of nitrogen in the first season. However, in the second season the highest number of flowers/plant were obtained at the widest plant spacing.

Flower age (days): Results (Fig. 1) showed that, both nitrogen and plant spacing had no significant effect in flower age in the first season (2006/2007), whereas, in the second season (2009/20 10) both nitrogen and plant spacing showed significant increase in flower age, nitrogen level 25 KgN/fed gave the highest value. In both seasons, the interaction showed that, flower age was increased with addition of 'nitrogen irrespective of plant spacing.

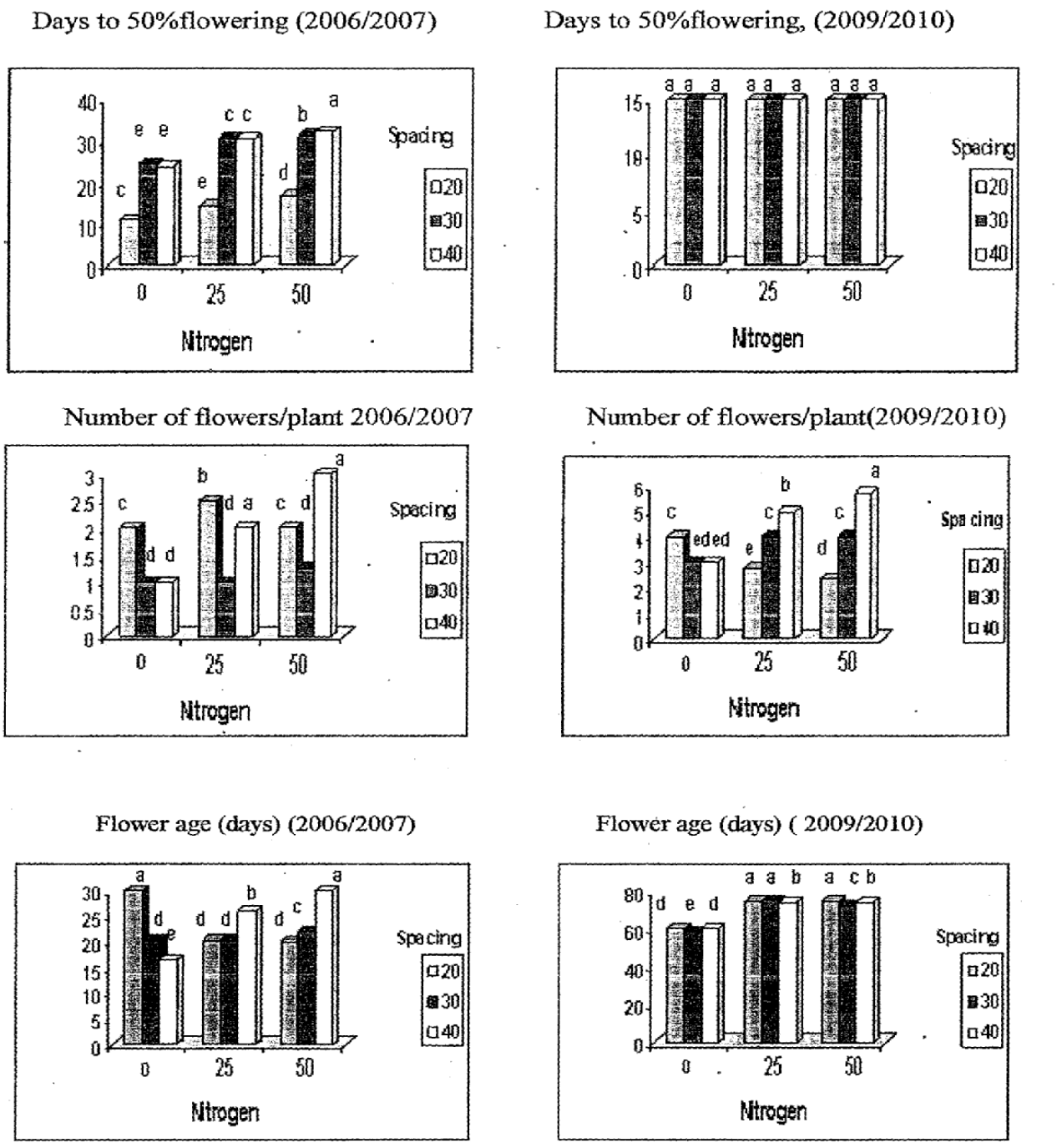

Fig. 1: Effect of nitrogen (as urea) and plant spacing in flower yield and quality (number of days to 50% flowering, number of flowers/plant and flower age) of C.cristata, in two summer seasons.

Seed yield: Number of seeds/flower: Results in (Table 2) showed that, both nitrogen and plant spacing showed significant increase in number of seeds/flower, in both seasons. The highest value was recorded at plant spacing of 40cm. Nitrogen showed significant increase. The highest value was recorded by addition of nitrogen. The interaction showed significant effect. However, number of seeds increased by increasing both nitrogen and plant spacing.

Number of seeds/plant: As in (Table 2) addition of nitrogen increased the number of seeds/plant up to 25KgN/fed. By plant spacing there was a decrease in number of seeds/plant by increasing spacing u to 3 0cm. However, increasing plant spacing up to (40cm) increased the seed number. By the interaction between plant spacings and nitrogen there was increasing in number of seeds/plant by increasing both nitrogen and plant spacing in both seasons.

Table 2: Effect of nitrogen (as urea) and plant spacing in seed yield (number of seeds/flower and number of seeds/plant) of celosia, in two summer seasons.

Season.	Spacing (cm)	Number of seeds/flower				Number of seeds/plant			
		Nitrogen (as urea) (KgN/fed)							
		0	25	50	Means	0	25	50	Means
First season: 2006/2007	20	870.0^{i}	961.3^{h}	1120.0^{f}	983.8^{c}	2100.0^{f}	3973.0^{f}	3228.0^{d}	3100.4^{b}
	30	691.7^{g}	1986.7^{c}	1610.7^{d}	1603.3^{b}	1740.0^{i}	1922.7^{h}	2240.0^{e}	1967.6^{c}
	40	1212.7^{e}	2493.3^{b}	2723.3^{a}	1969.4^{a}	1383.3^{g}	4986.0^{b}	5200.0^{b}	3856.7^{a}
	Means	924.8^{b}	1813.8^{a}	1818.0^{a}		1741.1^{b}	3627.6^{a}	3556.0^{a}	
	C.V.	3.5				3.1			
Second season: 2009/2010	20	325.7^{g}	364.3^{i}	402.0^{h}	364.0^{c}	1102.0^{h}	1123.3^{d}	800.7^{e}	1008.7^{b}
	30	522.3^{e}	438.0^{f}	545.7^{c}	502.0^{b}	1503.3^{b}	1327.3^{c}	1111.3^{c}	1314.1^{a}
	40	543.7^{d}	548.3^{b}	754.3^{a}	615.4^{a}	763.4^{a}	1144.3^{e}	2320.3^{a}	1409.2^{a}
	Means	463.9^{b}	450.2^{b}	567.3^{a}		1122.8^{b}	1198.3a^{b}	1410.9^{a}	
	C.V	1.7				16.7			

Means within the same column with similar letter are not significantly different at ($P<0.05$) according to Duncan's multiple range test.

Seed quality: From the results (Table 3) it was noticed that, there was no Significant increase at thousand-seeds, weight in both seasons.

Germination percentage: In the first season plant spacing gave significant increases in germination percentage. However, plant spacing had no significant effect in the second season. The interactions showed significant effect. Increasing of both plant spacing and nitrogen increased germination percentage in both seasons, The highest values were recorded by nitrogen regard of plant spacing (Table 3)

Table 3: Effect of nitrogen (as urea) and plant spacing in weight of thousand seed and germination percentage of Celosia, in two summer seasons.

Season .	Spacing (cm)	Number of seeds/flower				Number of seeds/plant			
		Nitrogen (as urea) (KgN/fed)							
		0	25	50	Means	0	25	50	Means
First season: 2006/2007	20	0.5[a]	0.5[a]	0.5[a]	0.5[a]	90.3e	98.0b	98.7b	95.7a
	30	0.5[a]	0.5[a]	0.51[a]	0.5[a]	83.0b	99.3a	100.0a	94.3b
	40	0.5[a]	0.5[a]	0.5[a]	0.5[a]	81.0	91.7d	96.0c	89.6c
	Means	0.5a	0.5a	0.51a		85.0c	96.3b	98.2a	
	C.V.	0.1				0.5			
Second season: 2009/2010	20	0.5[a]	0.5[a]	0.5[a]	0.5[a]	91.0[e]	100.0[a]	100.0[a]	97.0a
	30	0.5[a]	0.5[a]	0.51[a]	0.5[a]	96.3[b]	100.0[a]	100.0[a]	98.8[a]
	40	0.5[a]	0.5[a]	0.5[a]	0.5[a]	81.0	100.0[a]	100.0[a]	98.8[a]
	Means	0.5[a]	0.5[a]	0.5[a]		94.6[b]	100.0[a]	100.0[a]	
	C.V.	0.1				0.5			

Means within the same column with similar letter are not significantly different at ($P<0.05$) according to Duncan's multiple range test.

Germination rate: In both seasons, addition of nitrogen or increasing plant spacing and their interaction showed no significant effect in germination rate in both seasons. Moreover, wider spacing negatively affect germination rate (Table 4).

Germination uniformity: As in (Table 4) application of nitrogen and plant spacing showed no significant effect in germination uniformity in both seasons. The interaction between nitrogen and plant spacing had significant effect on germination uniformity. The highest values were obtained at plant spacing (20, 30cm and 25, 5OKgN/fed) (Table 4).

4. Discussion

All plants require sufficient supply of minerals to complete their life cycle. However, an optimum and balanced level of nutrients is necessary for an optimum growth and high quality production of flowers and; seeds of ornamental plants. Also spacing both within and between rows affect plant population which affects growth and yield due to competition.

The results revealed that, application of (urea or .manure) promoted growth of summer annual C.cristata. It gave the highest values of growth parameters, flower production and seed yield and quality. Addition of middle level (25KgN urea and 150Kg manure) gave the best vegetative growth of in both seasons compared to control.

Application of 50 kgN/fed urea and 300Kg manure produced maximum number of branches/plant and leaves compared to 25 kgN/fed on zinnia. These confirmed the results found by [2] working with nitrogen on China aster (Callistephus chinensis). [3] used different levels of manure (10, 20, 3 0 and 40 t/ha) obtained the highest vegetative growth at 40 t/ha. [4] working with nitrogen on zinnia. Recorded its response uptol5OKgN/fed. [5] evaluated effect of four types of composted waste as soil amendments for bedding plants (petunia, zinnia, geranium and marigold) and examined the effect of these amendments with or without sulfur (3 lbs per 100 ft) on the soil pH. Two sources of decomposed yard waste, composed leaves and peat were applied in two inches layer and corporate in the field. The overall amendments improved growth and appearance compared to unamendment. In general, the peat plots produced the greatest number of superior plants with the greater fresh and dry weight. [6] worked with nitrogen in carnation. [1] who worked with zinnia, marigold, and petunia using (chicken manure) as source of nitrogen, got best vegetative growth (plant height, number of branches/plant and number of leaves/plant) due to nitrogen compared to foliar fertilizer. [7] who studied effect of water soluble fertilizer in (Dianthus caryophyllus). [8] working with nitrogen in zinnia. [9] studied effect of green manure of tithonia diverse, foliar ‘plant in (Celosia argentea) at the rates of (0, 2.5, 5, 7.5, 10 and 20 tons/ha) fresh weight base. Results indicated that plant height; number of leaves and stem length were increased significantly.

Maximum flowers yield and quality were observed in celosia by using of manure at level of 25 kgN/fed compared to 50KgN/fed. These results are similar to those obtained by [2] working on china aster (Callistephus chinensis) and nitrogen at (60, 120 or 180 KgN/ha) and P_2O_5 at (60, 120 or 180 KgN/ha in all possible combination. The best results in terms of flower yield and quality obtained at the highest rate of both elements. [10] Reported that application of nitrogen at the rate of 90KgN/ha resulted in greatest flower diameter and flower yield of chrysanthemum. [11] used (500ppm, l000ppm) and (l500ppm) of nitrogen on carnation. Found that nitrogen (500ppm) improved number of flowers/plant and yield/rn2.

Maximum seed yield and quality were observed in celosia due to application of nitrogen (urea or manure) at level of 50 kgN/fed compared to 25KgN/fed. These results are similar to the finding by [5]) who evaluated effect of four types of composed waste as soil amendments for bedding annual plants (petunia, zinnia, geraniurn and marigold). The performance with regard to all parameters included in these experiments was poor in control. Nitrogen is considered to be crucial because it is a constituent of protein and nucleic acid which promotes rapid growth. Moreover, the suitable concentration of nitrogen has tendency to increase number and size of leaf cells with an increase of over all leaf production. [12,13] suggested that increasing in respiratory loss of C02 with increasing nitrogen fertilizer might explained why nitrogen increased vegetative growth and other yield components.

The results showed that, increasing of plant spacing decreased plant height but increased number of ‘branches/plant in all tested crops in both seasons. Similar results were obtained by [14] who reported that wider spacing (40cm) gave maximum number of branches/plant while closer spacing (20 and 30Cm) gave the highest values of plant height of mint plants. [15] reported that wider spacing increased number of lateral shoots and number of branches and leaves/plant.

The recorded data showed that spacing had no significant effect in flower number of celosia whereas, closer spacing delayed flowering of carnation. The same were found by [16] who examined effect of spacing on flowering of tuberose, and noticed that closer spacing delayed flowering compared to wider spacing. [17] did not notice any effect of spacing in days to 50% flowering in pansy.

Maximum flowers yield and quality (number of flowers/plant or inflorescences, flower diameter and flower age) of celosia, were recorded at spacing 30 and 40 cm. These results agree with those of [18] who recommended 30 x 30cm for zinnia in the field. Whereas, [19] achieved a highest number of flowers/plant of zinnia at 20 x 20cm spacing. However,

The maximum number of seeds, germination rate and uniformity of Celosia were recorded at closer spacing (20,30cm). These results agree with those of [20, 21] who obtained the highest number of seed/plant and maximum seed quality of amaranths, china aster and ageratum respectively. [22] recorded maximum seed yield with wider spacing (40 x 30cm) compared to closer spacing (30 x 20cm) in zinnia. [15] found that closer spacing resulted in highest number of seeds/plant compared to wider spacing in marigold. [23] noticed that maximum seed yield of lettuce was achieved at wider spacing. The physiological explanation is that increasing of plant density per unit area increased plant height might be due to inter-plant competition for space, light and nutrients. Similar explanation was recorded by [24] working on comparative effectiveness of some compost formulation for maize.

5. Conclusion

The objectives of this study were to find out the effect of plant population and nutrition management in growth, flowering and seeds yield and quality of summer and winter annual ornamental plants, summer annuals Celosia cristata . Also the objective was to assess the ability of this plants to produce seeds under our condition. To achieve these objectives two experiments were conducted and repeated for two seasons in winter and summer. Spacing 20, 30 and 40cm urea at levels of 0, 25 and 50 kgN/fed and animal manure at levels of 0,150 and 300Kg/fed were applied among whole plants.The finding of this study showed that: 1. Spacing treatment showed significant effect in growth (plant Height, number of branches/plant and number of leaves/plant) among tested plant (celosia, 2. Application of both (urea and manure), gave positive results in growth among tested plants compared to control.3. Interaction showed significant effect in vegetative growth. 4. Flower yield and quality (days to 50%floweriiig, number of flowers/plant, flower diameter and flower age) showed significant response to spacing, highest value recorded by spacing 40cm followed by 30cm then 20cm. 5. Urea or manure gave highest value of flowers yield and quality among tested crops. 6. Interaction also showed significant effect in flower yield and quality, while number of days to 50% flowering increased by increasing nitrogen. 7. Spacing treatments showed significant effect in seed yield ‘and seed quality among tested crops. 8. Application of (either urea or manure) showed significant effect in seed yield and quality. 9. Interactions showed significant effect in seed yield and quality 10. All tested plants (celosia, zinnia, antirrhinum and carnation) are promising, and they are adapted with our environment so they can be propagated as source for seed production locally instead of imported seeds with hard currency.

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