ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 7, Issue, 02, pp.12779-12782, February, 2015

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

EFFECT OF MANURE FERTILIZER AND SPACING ON GROWTH, YIELD AND QUALITY OF ZINNIA FLOWERS

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ARTICLE INFO

Article History:
Received 22nd November, 2014
Received in revised form
20th December, 2014
Accepted 17th January, 2015
Published online 28th February, 2015

Key words:
Zinnia elegans,
Manure,
Spacing,
Yield and quality.

ABSTRACT

This study was carried out to investigate the effects of treatments with manure fertilizer and spacing on growth and quality of Zinnia elegans flowers. Zinnia is a popular garden annual flower. The results revealed that, application of sources of manure promoted growth of Zinnia elegans. It gave the highest values of growth. Addition 300kg/fed manure gave the best vegetative growth of Z. elegans. compared to 150kgs manure. High doses of both urea and manure delayed flowering in plant Z.elegans. Moreover, flowers yield and quality, seed yield and quality were affected positively by addition of manure. 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 Z elegans. Maximum flowers yield and quality (number of flowers /plant or inflorescences, flower diameter and flower age) of Zinnia were recorded at spacing of 30and 40cm.Maximum number of seeds germination rate and uniformity of Zinnia elegans were recorded at closer spacing (20,30cm).

INTRODUCTION

Annual flowering ornamental plants are those plants which end their life cycle within one growing season. 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) (**Mukhtar, 2003**).

The researches on adopting annual ornamental plants are 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 on 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.

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MATERIALS AND METHODS

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.

The plant material

The summer annual plants used were Zinnia elegant. The F1 hybrid seeds of Z. elegans were imported from Holland

Experiment 1. 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 Z.elegans 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

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.

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

Number of leaves/plant: The total number of leaves of the same plant was counted and the average number of leaves/plant 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 recoded. 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 as follows: 1. Weight of thousand seeds (gm.), 2. Germination Percentage (G.%), 3. Germination rate (G.R.), 4. Germination uniformity (G.U.)

RESULTS

Plant height (**cm):** The results showed that, in both seasons, addition of manure increased plant height significantly. Increasing of plant spacing decreased plant height up to 30cm. Increasing in plant height was obtained with increasing of spacing up to 40cm. Increasing of manure increased plant height within the same plant spacing (Table 1). Number of branches/plant: In both seasons the highest number of branches were obtained at 300kg/fed manure (Table 1).

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

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

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

Number of seeds/plant: As in (Table 2) addition of manure 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 up to 3 0cm. However, increasing plant spacing up to (40cm) increased the seed number. By the interaction between plant spacing and manure fertilizer there was increasing in number of seeds/plant by increasing both manure and plant spacing in both seasons.

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 1. Effect of manure and plant spacing in vegetative growth (plant height, number of branches/plant and number of leaves/plant) at 50% flowering of zinnia, in two summer seasons

Season	Spacing (cm)	Plant height (cm)				Number of branches/ plant				Number of leaves /plant			
		manure kg /fed											
		0	150	300	Means	0	150	300	Means	0	150	300	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.

Table 2. Effect of manure and plant spacing in seed yield (number of seeds/flower and number of seeds/plant) of zinnia, in two summer seasons

Season	Spacing (cm)	Number of seeds/flower				Number of seeds/plant			
		manure (Kg/fed)							
		0	150	300	Means	0	150	300	Means
First season:	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}
2006/2007	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	
	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}
Second	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}
season:	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}
2009/2010	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

Table 3. Effect of manure and plant spacing in weight of thousand seed and germination percentage of Zinnia, in two summer seasons

Season	Spacing (cm)	Number of seeds/flower				Number of seeds/plant			
		Manure(Kg/fed)							
		0	150	300	Means	0	150	300	Means
First season:	20	0.5^{a}	0.5^{a}	0.5^{a}	0.5^{a}	90.3e	98.0b	98.7b	95.7a
2006/2007	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:	20	0.5^{a}	0.5^{a}	0.5^{a}	0.5^{a}	91.0^{e}	100.0^{a}	100.0^{a}	97.0a
2009/2010	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.

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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 .manure promoted growth of summer annual *Z. elegans*. It gave the highest values of growth parameters, flower production and seed yield and quality. Addition of middle level (150kg and 300kg manure gave the best vegetative growth of in both seasons compared to control. Application of 300kg/ fed manure produced maximum number of branches/plant and leaves compared to 150kg/fed on zinnia. These confirmed the results found by (**Reddy, 1978**) working with nitrogen on China aster (Callistephus chinensis). (**Rose and Wang, 1995**) 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 un amendment. In general, the peat plots produced the greatest number of superior plants with the greater fresh and dry weight. (**Mukhtar, 2003**) 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. (**Bhatia, 2004**) who studied effect of water soluble fertilizer in (Dianthus caryophyllus (**Shokalu *et al.*, 2010**) 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. (**Bialey and Bialey 1976**) Reported that application of manure at the rate of 90Kg/ha resulted in greatest flower diameter and flower yield of chrysanthemum.

Maximum seed yield and quality were observed in Zinnia due to application of manure at level of 300 kg/fed compared to 150Kg /fed. These results are similar to the finding by (**Shokalu *et al.*, 2010**)) 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. Manure is considered to be crucial because it is a constituent of protein and nucleic acid which promotes rapid growth. (**Pearman *et al.*, 1976; Eghaveba and Ogbe 2002**) suggested that increasing in respiratory loss of C02 with increasing manure fertilizer might explained why manure 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 (**Salim, 1993**) 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.

(**Sunitha, 2006**) 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 zinnia whereas, closer spacing delayed flowering of carnation. The same were found by (**Singh, 1996**) who examined effect of spacing on flowering of tuberose, and noticed that closer spacing delayed flowering compared to wider spacing. (**Jinendra, 1997**) Did not notice any effect of spacing in days to 50% flowering in pansy. The maximum number of seeds, germination rate and uniformity of Zinnia were recorded at closer spacing (20,30cm). These results agree with those of (**Mnzaua and Reuben, 1982; Balachandra *et al., 2004***) who obtained the highest number of seed/plant and maximum seed quality of amaranths, china aster and ageratum respectively. (**Poonam and Dubey, 2002**) Recorded maximum seed yield with wider spacing (40 x 30cm) compared to closer spacing (30 x 20cm) in Zinnia elegans, and also found that closer spacing resulted in highest number of seeds/plant compared to wider spacing in marigold. (**Firoz *et al.*, 2009**) 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 (**Adedran and Banoko, 2003**) working on comparative effectiveness of some compost formulation for maize.

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 Zinnia elegans. Also to assess the ability of this plant to produce seeds under our condition. To achieve these objectives an experiment was conducted and repeated for two seasons in summer. Spacing 20, 30 and 40cm animal manure at levels of 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 Zinnia elegans 2. Application of manure, gave positive results in growth among tested plants compared to control.3. Interaction showed significant effect in vegetative growth. 4. Spacing treatments showed significant effect in seed yield ‘and seed quality among tested crops. 5. Application of (either urea or manure) showed significant effect in seed yield and quality.6. Interactions showed significant effect in seed yield and quality 10. All tested plants Zinnia elegans, are promising, and they are adapted with environment so they can be propagated as source for seed production locally instead of imported seeds.

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