Response of Zinnia (Zinnia elegans L.) to Different Fertilizers

إستجابة نبات الزينيا لأنواع مختلفة من الأسمدة

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Abstract:

A pot experiment was conducted to study the response of Zinnia (*Zinnia elegans* L.) to different fertilizers. Fertilizer treatments were: chicken manure at the rate 10 g/pot, Agrofeed (19 : 19 : 19 + TE) at the rate of 2 g/pot, Foliar Broxal (11 : 8 : 6) at the rate of 3 ml/ litre of water and the control. Chicken manure resulted in the highest plant height, number of branches/plant, plant fresh and dry weights number of leaves/plant. Agrofeed resulted in the highest value of stem diameter. Zinnia plants supplied with Agrofeed showed the earliest flowering . The Latest flowering was shown by Foliar Broxal and chicken manure. Chicken manure resulted in the highest number of inflorescences/plant and inflorescence diameter. There was no significant difference in inflorescence weight among treatments. Since inorganic fertilizers are sometimes not available and are always rather expensive for the low-income, small-scale producers, this study recommends the use of chicken manure for zinnia as an alternative for the inorganic fertilizers. Further studies on complementary use of organic and mineral fertilizers are needed so as to determine the optimal rate of combining the organic and the inorganic fertilizers as well as the optimal rate of application in zinnia and other flowering plants as an integrated nutrient management system.

Key words: *Zinnia*, Fertilization, Chicken manure, Growth, Flowering.

المستخلص:

أجريت تجربة أصيص لدراسة إستجابة نبات الزينيا لأنواع مختلفة من الأسمدة. الأسمدة التي أختبرت كانت: مخلفات الدواجن بمعدل ١٠ جرام/أصيص، أقروفيد (١٩ : ١٩: ١٩ + عناصر صغرى) بمعدل ٢ جرام/أصيص، والسماد الورقي بروكسال (١١: ٨ : ٦) بمعدل ٣ مل للتر الماء والشاهد. سماد مخلفات الدواجن نتج عنه أعلى ارتفاع للنبات و عدد الأفرع بالنبات و وزني النبات الطازج والجاف و عدد الأوراق بالنبات متساويا مع الأقروفيد. سماد الأقروفيد نتج عنه أعلى قيمة لقطر الساق. نباتات الزينيا المضاف إليها سماد الأقروفيد أظهرت ازهارا أكثر تبكيرا. الازهار الأكثر تأخيرا نتج من السماد الورقي بروكسال و مخلفات الدواجن. سماد مخلفات الدواجن نتج عنه أعلى عددا للنورات بالنبات و أعلى قطرا للنورة. لم يكن هنالك فرق معنوي بين المعاملات في وزن النورة. بما أن الأسمدة الغير عضوية تكون غير متوفرة أحيانا و مكلفة بالنسبة لصغار المنتجين أصحاب الدخل المحدود فإن هذه الدراسة توصي باستخدام مخلفات الدواجن للزينيا كبديل للأسمدة الغير عضوية. هناك حوجة لدراسة لاحقة حول الاستخدام المتكامل للأسمدة العضوية و

غير العضوية لتحديد المعدل الأمثل لتوليفهما مع بعضهما و المعدل الأمثل للإضافة في الزينيا ونباتات مزهرة أخرى كنظام تسميد متكامل.

كلمات مفتاحية: زينيا ، التسميد، مخلفات الدواجن، النمو، الازهار.

INTRODUCTION

The Genus *Zinnia* is a member of the family Asteraceae. It comprises about 20 species, native to North and South America and originated in Mexico. It contains annual and perennial plants notable for their solitary long-stemmed flower that come in variety of bright colors. The height of the plant range from 15 cm to 1 meter (Boyle and Stimart, 1986). In Sudan Zinnia is one of the popular annual ornamental plants. Zinnia can be used as cut flowers, a bedding plant, a potted flowering plant, for mass planting as edging or filler plants. Creeping Zinnia is usefull for rock gardens, containers and hanging baskets. In the landscape, Zinnias are tolerant of all except wet, poorly aerated soils that can cause root rot (Kessler, 2008). Foliar feeding is the practice of applying liquid fertilizers to plant leaves. Foliar fertilizers are absorbed right at the site where they are used as quite fast acting, whereas, much of the soil fertilizers may never get used by plants (Schonherr, 2006). Foliar application is one of the methods to overcome failure of plants to absorb certain nutrients necessary for development in soils that have high pH value (Halder *et al.* 2007). The positive effects of foliar fertilization on growth and flowering of plants have been recorded by many research workers (Mahgoub *et al.*, 2010 in *Schefflera*; Ahmad *et al.* 2010 and Younis *et al.*, 2013 in *Rosa hybrida*; Khosa *et al.*, 2011 in gerbera and Hameed *et* al., 2014 in Dahlia). Application of chemical fertilizers have harmful effects on soil flora, fauna, and enzymes. This ultimately leads to decrease their activity for maintaining the natural fertility of soil (Gupta *et al*. 2014). In order to use soil nutrients more efficiently and to overcome pollution hazards the application of organic matter is gaining acceptance among farming communities (Riyaz, *et. al*. 2015). Organic materials from agriculture, forestry, green areas, and livestock farming as well as residues from municipal and industrial waste are rich sources of different nutrients (Fitzpatrick, 1986) and all have been strongly recommended for use as renewable resources in pot production, an effort that would help to palliate their harmful impact on local and global environmental degradation (Ribeiro *et al*. 2007). The positive effects of organic amendments could be attributed to their effects in supplying the

treated plants with their requirements of nutrients for relatively long time as well as their effects in lowering soil pH which could aid in facilitating availability of soil nutrients and improve physical characters in favour of roots development (Gamal and Ragab, 2005). The positive effects of using organic amendments with growing media on vegetative growth and flowering of plants have been recorded by many research workers (Kiran *et. al*. 2007 in *Dahlia pinnata* ; Gupta *et al*. 2014 in marigold and Riyaz, *et. al*. 2015 in *Gerbera jamesonii*). Recently, there has been an increasing interest in production of ornamental flowering plants in Sudan and hence reliable research data is required. This study was carried out to study the response of *Zinnia elegans* to different fertilizers.

MATERIALS AND METHODS

A pot experiment was conducted at the nursery of the Department of Horticulture, Faculty of Agriculture, University of Khartoum, Sudan to study the response of Zinnia (*Zinnia elegans* L.) to different fertilizers. Seedlings of Zinnia about one month age were transplanted into polyethylene bags of 25 cm diameter and 30 cm height potted with silt. Treatments were chicken manure at the rate 10 g/pot, Agrofeed (19 : 19 : 19 + TE) at the rate of 2 g/pot, Foliar Broxal (11 : 8 : 6) at the rate of 3 ml/litre of water and the control. Chicken manure was thoroughly incorporated with soil and the mixture irrigated one week before transplanting. Agrofeed was broadcasted on the surface of the soil as one application. Foliar Broxal was sprayed at two weeks interval starting on the third week after transplanting, three times throughout the growing season. Some properties of of silt and chicken manure are shown in tables 1 and 2 respectively. Treatments were arranged in a completely randomized design. Six plants represented an experimental unit, and each experimental unit was replicated four times. Statistical analysis was carried out using the SPSS program version 9. Mean separation was carried out using Duncan's multiple range test at 5% level of significance. Growth and flowering parameters measured were plant height, number of branches/plant, number of leaves/plant, stem diameter, plant fresh weight, plant dry weight, days to first flower bud emergence, number of flowers/plant, flower diameter and flower weight.

Table (1): Some properties of silt:

pH	E.Ce	Ca + Mg Meq/L	Ca Meq/L	P ppm	N %	Na Meq/L	S.P	K Meq/L	M.C%
7.51	0.700	8.50	6.00	13.95	0.06	0.98	52.84	0.18	5.0

Table (2): Some properties of chicken manure:

EC e	pH (Past e)	Ca %	Mg %	Na %	K %	N %	P %	Ash %	O.C %	Fe ppm	Cu ppm	Zn ppm	Mn ppm
14	6.80	5.10	5.1	0.44	0.59	3.23	4.03	53.7	34.10	15.10	2.1	3.12	13.42

RESULTS AND DISCUSSION

Effect of different fertilizers on vegetative growth of *Zinnia elegans*:

Plant height:

As shown in table 3, there was a significant difference in Plant height among treatments. Chicken manure resulted in the highest plant height differing significantly from only Agrofeed (19:19 :19 + TE). This result is comparable with that of Oyedeji *et al.* (2014) who found that application of poultry manure markedly increased plant height of *Amaranthus deflexus* compared to NPK. The result is also comparable with that of Sodimu (2020) who obtained higher vine length of cucumber using poultry manure compared to NPK. A similar result of plant height was reported by Isitekhale *et al.* (2013) in tomato.

Number of branches/plant:

Chicken manure resulted in significantly the highest value of number of branches/plant than the rest of the treatments that had no significant differences among themselves (table 3). This result is comparable with that of Bi *et al* (2010) who found that application of poultry manure markedly increased Plant growth index = [(height + width + perpendicular width) ÷ 3] in French marigold compared to NPK. Daramola *et al.* (2006) reported higher profuse branches of *Amaranthus cruentus* due to the application of organic N (poultry manure) when compared to inorganic N (urea).

Number of leaves per plant:

Chicken manure and Agrofeed resulted in significantly higher values of number of leaves/plant than Foliar Broxal and control with the two former treatments and the latter two treatments differing

nonsignificantly among themselves (table 3). In fertilization study on cucumber, Sodimu (2020) obtained higher number of leaves/plant using poultry manure compared to NPK. Daramola *et al.* (2006) reported higher profuse leaves of *Amaranthus cruentus* due to the application of organic N (poultry manure) when compared to inorganic N (urea). Comparing the growth, yield, and proximate composition of *Amaranthus hybridus* and *Amaranthus cruentus* grown with poultry manure and NPK in relation to the unfertilized soil, Oyedeji *et al.* (2014) found no significant difference in number of leaves/plant among treatments. The effects of organic fertilizers on plant growth seem varied, and some studies showed decreased plant growth or yields when using organic fertilizers compared with conventional fertilizers. This variation could be the result of the differences in organic fertilizer sources being used and application rates and timing . Variation may also be the result of differences in nutrient availability and mineralization rates of various nutrient fractions under the environmental and horticultural conditions of each study (Bi *et al* 2010).

Stem diameter:

Agrofeed NPK fertilizer (19:19:19 +TE) resulted in significantly the highest value of stem diameter than the rest of the treatments that had no significant differences among themselves (table 3). This result is in line with that of Oyedeji *et al.* (2014) who compared growth, yield, and proximate composition of *Amaranthus hybridus, Amaranthus deflexus* and *Amaranthus cruentus* grown with poultry manure and NPK in relation to the unfertilized soil and found that application of NPK markedly increased stem diameter compared to poultry manure and control.

Plant fresh and dry weights:

As shown in table 4, fresh and dry weights recorded by chicken manure were significantly higher than the control. Poultry manure added to peat as substrate for container grown *Impatiens wallerana* (common impatiens) doubled the fresh and dry mass compared to peat alone (Dede, *et al*. 2006). In *Amaranthus cruentus* application of organic N (poultry manure) resulted in higher shoot dry matter compared to inorganic N as urea (Daramola *et al.*, 2006). Bi *et al* (2010) found that application of poultry manure markedly increased shoot dry weight of marigold. In forage sorghum high rate of chicken manure significantly increased dry and fresh

yield (Abusuwar and Elzilal, 2006). The higher organic material and nitrogen content, and easy mineralization of nitrogen in chicken manure might have been responsible for such a positive response (Adegbidi and Briggs, 2003).

Effect of different fertilizers on flowering of *Zinnia elegans*:

Days to first flower bud emergence:

As shown in table 5, zinnia supplied with the complete fertilizer Agrofeed (19+19+19+TE) showed earliest emergence of first flower bud (20.66 days). This result is in agreement with previous finding reported by Baloch, *et al.* (2010) who worked on Zinnia (*Zinnia elegans L*.) and found that plants supplied with the highest rate of N.P.K. were earliest in flowering. This could be attributed to the fact that complete fertilizer (N.P.K + TE) supplied the plants with the N.P.K together with essential micro nutrients which promote early growth and flowering of Zinnia. Latest emergence of first flower bud was shown by Foliar Broxal (31.16 days) and chicken manure (30.66 days). Foliar Broxal being applied three times throughout the growing season and chicken manure slow releasing nutrition for a long period, both treatments might have prolonged the vegetative growth period and caused the delayed flowering. Similar observations regarding chicken manure were reported by Ayesha, *et al.* 2011in strawberry and Ahmed et al. (2004) in dahlia plant.

Number of inflorescences per plant

Chicken manure resulted in the highest number of inflorescences/plant differing significantly from the rest of the treatments (table 5). It may be because the plant growth and its yield are highly dependent upon the crown size. Generally large crown produce maximum number of flower buds (Bartczak *et al.,* 2007). In our investigation chicken manure had positive effect on the crown size (high number of branches and number of leaves per plant as shown in table3) and hence may be held responsible for the increase in the number of inflorescences/plant. Similar results regarding the effect of chicken manure on flowering were reported by other research workers (Bi *et al.* 2010 in French marigold, Dede, *et al*. 2006 in *Impatiens wallerana*, Ayesha, *et al.* 2011in strawberry, Sodimu 2020 in cucumber).

Inflorescence diameter (cm):

As shown in table 5, chicken manure resulted in significantly the highest inflorescence diameter compared to the rest of the treatments among which there was no significant difference. Similar result was recorded by Ayesha, *et al.* (2011) in strawberry. According to Riaz *et al.* (2008) Other organic fertilizers (coconut compost) can significantly improved the flower size in zinnia plant.

Inflorescence weight (gm):

As shown in table 5, there was no significant difference in inflorescence weight among treatments. However the highest inflorescence weight was recorded by the complete fertilizer Agrofeed (19:19:19 +TE) followed by chicken manure. In marigold plant poultry manure produced the highest total flower dry weight compared to NPK osmocote slow release fertilizer and the control (Bi *et al.*, 2010). The effects of organic fertilizers on plant growth seem varied, and some studies showed decreased plant growth or yields when using organic fertilizers compared with conventional fertilizers (Ali, 1997; Peet *et al*., 2004). This variation could be the result of the differences in organic fertilizer sources being used and application rates and timing (Rosen and Allan, 2007). Variation may also be the result of differences in nutrient availability and mineralization rates of various nutrient fractions under the environmental and horticultural conditions of each study (Bi *et al.*, 2010). Further studies on complementary use of organic and mineral fertilizers are needed so as to determine the optimal rate of combining the organic and the inorganic fertilizers as well as the optimal rate of application in zinnia and other flowering plants.

Table (3): Effect of different fertilizers on growth parameters of Zinnia *(Zinnia elegans)* twelve weeks after transplanting.

Fertilizers	Plant height (cm)	Number of branches/plant	Number of leaves per plant	Stem diameter (mm)
Chicken manure	61.08a	3.79a	15.79a	4.06b
Agrofeed (19:19:19 +TE)	53.50b	2.91b	15.85a	4.45a
Foliar Broxal (11 : 8 : 6)	59.30ab	2.95b	14.29b	3.87b
Control	59.75ab	2.68b	13.50b	3.58b

Means followed by the same letter (s) in a column are not significantly different at P=0.05 according to Duncan's Multiple Range Test.

Table (4): Effect of different fertilizers on growth parameters (plant fresh and dry weights) of Zinnia *(Zinnia elegans)* twelve weeks after transplanting.

Fertilizers	Plant fresh weight (gm)	Plant dry weight (gm)
Chicken manure	73.56 a	15.40 a
Agrofeed (19:19:19 +TE)	71.31 ab	14.73 ab
Foliar Broxal (11 : 8 : 6)	62.70 ab	14.45 ab
Control	59.91 b	12.35 b

Means followed by the same letter (s) in a column are not significantly different at P=0.05 according to Duncan's Multiple Range Test.

Table (5): Effect of different fertilizers on flowering of Zinnia *(Zinnia elegans)*.

Fertilizers	Days to first flower bud emergence	Number of inflorescences per plant	Inflorescence diameter (cm)	Inflorescence weight (gm)
Chicken manure	30.66a	2.18a	6.58a	4.76a
Agrofeed (19:19:19 +TE)	20.66c	1.62b	4.90b	5.15a
Foliar Broxal (11 : 8 : 6)	31.16a	1.71b	4.43b	3.81a
Control	23.83b	1.50b	3.83b	3.20a

Means followed by the same letter in a column are not significantly different at P=0.05 according to Duncan's Multiple Range Test.

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