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DEVELOPMENT AND PRODUCTION OF ORNAMENTAL SUNFLOWER IN FUNCTION OF USE CATTLE MANURE

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ABSTRACT: The flower market is on the rise in Brazil. Among the most requested species stands out the ornamental sunflower.However, there are few studies related to the use of organic waste in its production.The objective evaluate the development and biomass production of ornamental sunflower Dwarf Garden under use ofcattle manure. The study was conducted from June to August 2014 in the greenhouse environment. The experimental design was completely randomized with five doses of cattle manure (0; 2.5; 5.0; 7.5 and 10.0 %) of the substrate volume, with five replications and five plants per plot. At 70 days after sowing, period in which the flower was at the R9 stage (physiological maturity), the harvest has begun. It was evaluated the root length, number of petals, green and dry phytomass of root, green and driesphytomass of petals, green and dry phytomasschapter with and without petals, days from the sowing to the appearance of the first floral bud and for initial opening and full of the floral bud. The cattle manure stimulates the production of petals, green and dry phytomass production and increases the precocity of the Sunflower Dwarf Garden. The organic fertilization with cattle manure is an efficient alternative for the production of ornamental sunflower.

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KEY WORDS: *Helianthus annuus* L.; Ornamental flowers; Organic residue; Agroecology.

DESENVOLVIMENTO E PRODUÇÃO DE GIRASSOL ORNAMENTAL EM FUNÇÃO DO USO DE ESTERCO BOVINO

RESUMO: O mercado de flores está em plena ascensão no Brasil.Dentre as espécies mais requeridas, destaca-se o girassol ornamental. Porém, são poucos os estudos relacionados ao uso de resíduo orgânico na em sua produção.Assim, objetivou-se avaliar o desenvolvimento e produção de fitomassa do Girassol ornamental Anão de Jardim sob uso deesterco bovino. O trabalho foi desenvolvido de junho a agosto de 2014 em casa de vegetação. Avaliaram-se cinco doses de esterco bovino (0, 2,5, 5,0, 7,5 e 10,0 %) do volume do substrato, utilizando-se o delineamento experimental utilizado foi inteiramente casualizado, com cinco repetições e cinco plantas por parcela. Aos 70 dias após a semeadura, período em que a flor estava no estágio R9 (maturação fisiológica), iniciou-se a colheita. Avaliaram-seas características de crescimento e produção da planta e pétalas. O esterco bovino estimula a produção de pétalas, a produção de massa verde e seca e aumenta a precocidade do Girassol Anão de Jardim.

PALAVRAS-CHAVE: *Helianthusannuus* L.; Flores ornamentais; Resíduo orgânico.

INTRODUCTION

The sunflower crop (*Helianthus annuus* L.) has great importance in the world due to the excellent quality of the edible oil, the use of extraction subproducts such as pies and / or meal for animal feed, its use in biofuel production and also the its use as an ornamental plant (CARVALHO *et al*., 2014; VERSYPLE *et al*., 2015).

The interest that the sunflower crop is awakening is due to the quality and the multiple use of its derived products and its wide adaptability to different soils and climatic regions of Brazil (PEREIRA *et al*., 2014), may constitute a further alternative crop, in view that this is a multiuse species, that owns varieties and cultivars that can compose both a grain production system and be used in the environments ornamentation (ANDRADE *et al*.,2014).

Sunflower was used as an ornamental plant and as a vegetable crop until

the eighteenth century, when it began its use as a commercial crop (JARDINI *et al*., 2014). Especially in recent years, the culture has also gained more prominence as an ornamental plant and consequently several lines of research have emerged to its agronomic improvement (NASCIMENTO *et al.*, 2013; SANTOS JUNIOR *et al*., 2014).

In 2014, the national cultivation of ornamental plants reached a total area of approximately 13770 ha, divided between crops in protected environments and outdoors, annually moving around R$ 4.5 billion to consumer level, becoming increasingly important in the national economy. Agribusiness of flowers and ornamental plants, including in the internet it be ramified by the country and conquer markets abroad (IBRAFLOR, 2014).

The beauty of the composite sunflower blossom is very appreciated, with great aesthetic value as an ornamental plant, so can be cultivated for the production of cut flowers and pot (CURTI *et al.*, 2012). Although the ornamental sunflower have potential for cultivation in large parts of the country, presenting itself as an alternative to the floriculture sector, because it is a culture without major difficulties of cultivation, proper crop management, especially fertilization becomes a crucial step in the success of the activity (ZOBIOLE *et al*., 2010; OLIVEIRA *et al*., 2013).

In the current perspective of the world, where it seeks greater efficiency and economy in production systems, the high level of application and the increasingly high price of chemical fertilizers has led producers, including florists to seek viable alternatives for their fertilization programs. Among the possible alternatives, the fertilizer arises with organic sources, such as cattle manure, which is an input of high efficiency, in view of the gradual release of nutrients, improvement of chemical, physical and biological qualities of soil (AMARANTE *et al.,* 2015).

The organic matter plays a crucial role in nutrition of the crops by promoting plant growth and better nutrient uptake supplied via fertilization (COSTA *et al*., 2013; ZANDONADI *et al*., 2014). Furthermore, the use of organic fertilizers such as organic compost and poultry manure, goats and cattle provides an improvement in moisture retention, in the aggregate, porosity and increases microbial activity of the soil (SOUSA *et al*., 2013).However, for the species are incipient the studies associated with this modality, making it necessary scientific investigations aiming to disseminate agronomic practices and that can reduce the possible environmental impacts by the correct use of the organic residue.

Given the above, the objective of this research was to evaluate the effects of fertilization with cattle manure in the development and production of phytomass in ornamental sunflower, cultivar Dwarf Garden.

2 MATERIAL AND METHODS

The study was conducted from June to August 2014 in the greenhouse environment.The experimental design was completely randomized, in which were studied different proportions of cattle manure and soil. Treatments (T) were constituted of five doses of cattle manure, T1 (0 % manure); T2 (2.5 % manure); T3 (5.0 % manure); T4 (7.5 % manure) and T5 (10.0 % manure) of the substrate volume, with five replications and five plants per plot. Each experimental unit was composed of a plant for polyethylene pot with a capacity of 3.6 L, filled with substrate 3.4 L.

The soil was collected in the surface layer (0-20 cm) of anEntisol Eutrophic, classified according to the criteria of the Brazilian System of Soil Classification - SiBCS (EMBRAPA, 2013).Prior to application bovine manure was tanned for a period of 100 days, this being coming from milk producers properties in the region, both were characterized, as fertility and salinity of the saturation extract using the methodologies contained in Donagema et al (2011). Analyses were performed by the Laboratory of irrigation and salinity of the Federal University of Campina Grande, Campus I, Campina Grande - PB (Table 1).

Table 1. Characterization of soil and cattle manure on fertility and salinity, before the start of the experiment

	pH	P	K^+	Na^+	$H^+ + Al^{+3}$	Al^{+3}	Ca^{+2}	Mg^{+2}	SB	CTC	V	M.O.S	ECse
	H_2O	--mg dm^{-3}---		----------cmol$_c$ dm^{-3}----------							%	-g kg^{-1}-	-dS m^{-1}-
Soil	6.97	223.7	70.2	0.40	0.0	0.0	2.7	1.37	4.63	4.63	91.36	0.53	0.13
Cattle manure	7.3	251.5	396.2	0.15	0.58	0.0	5.5	2.15	8.81	9.39	93.8	421.28	-

SB- Sum of Bases; CEC - Cation Exchange Capacity; V - Base Saturation; S.O.M - Soil Organic Matter; ECse - Electrical Conductivity of saturation extract; C. manure - Cattle manure.

After filling the pots in each experimental treatment were sown three seeds of ornamental sunflower Dwarf Gardening with a germination percentage of 92%. After stabilization of seedling emergence, what happened at 17 days after sowing (DAS), the thinning was carried out, leaving the strongest plant per experimental unit, to be carried out evaluations during the experimental period. The irrigation of the plants was performed in the early hours of the day, based on the determination of the volume calculation, perimeter, radius and area of the vessel, applying a blade of 100 % of evapotranspiration.

At 70 DAS began the harvest individually in the period in which the plant had the flower in the R5.10 stage, characterized by the full opening of the disc flowers (CASTRO; FARIAS, 2005). The variables analyzed were: root length, green and dry root phytomass, number of petals, green and dry petals phytomass, green chapter phytomass with and without petals, dry phytomass of the chapter with and without petals, days from seeding to the appearance of flower buds and initial and full opening of the flower bud.

The root length was evaluated based on the highest root with the help of millimetric ruler. The number of petals was measured by simple counting of the same without size measurement, this variable is of great relevance, in view with flowers with highest density of petals are considered more attractive and higher plastic beauty.

The phytomass was determined in grams, by weighing on electronic balance, the phytomass of the chapter was measured with and without petals to check the influence of the same in the green and dry mass of the chapter, because the petals are of great importance, especially when you are working with ornamental flowers, in view that through its intense yellow tint, plastic beauty of the flower is intensified. The appearance of the flower bud was established by the number of days from sowing to the moment when a sphere is seen in the center of the apical meristem. To evaluate the initial opening and final of flower bud, it was considered the count of days from sowing to the day that the first and all the petals (ligulate flowers) were opened completely, respectively (ANDRADE *et a*l., 2014).

The data were submitted to analysis of variance, and when significant by the F test, the means were submitted linear and polynomial regression ($p<0,05$), using the statistical software SISVAR-ESAL (FERREIRA, 2003).

3 RESULTS AND DISCUSSIONS

By the results of Figure 1A, it is observed that there was a linear increase in root length due to the cattle manure doses. The highest root length was obtained with the addition of 10% manure in the substrate, providing an increase of 24.3 cm compared to treatments without organic residue.

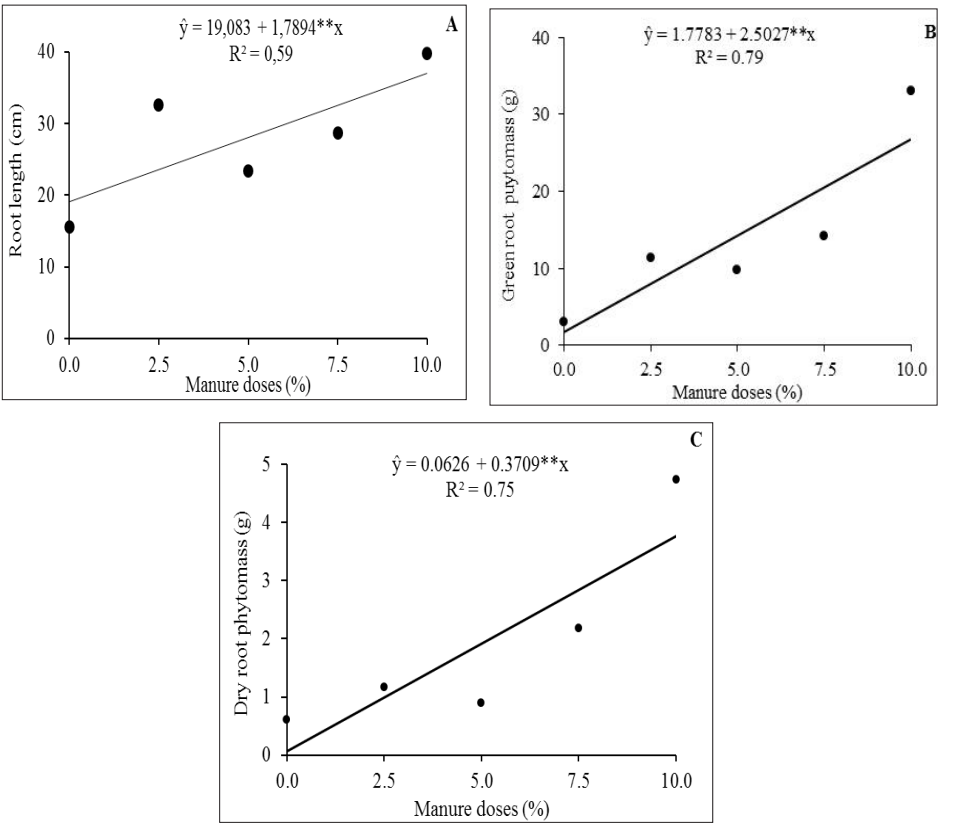

Figure 1. Root length (A), green root phytomass (B) and dry root phytomass (C) of Dwarf sunflower Garden, due to the addition of different dosages cattle manure.

Green root phytomass (Figure 1B) reached its maximum value (32.99 g), when cultivated to a dose of 10%of manure, increment of 29.89 g compared to treatments without organic residue(3,098 g), being the lowest value. The same trend occurred for the sunflower root dry mass (Figure 1C), with the largest mean value (4.94 g) in the substrate with the higher dose of manure (10% volume of the substrate), resulting in an increase 4.33 g compared to plants grown in substrate without manure (0.608 g).

The positive influence of the highest dose of cattle manure in the root length of ornamental sunflower may be related to greater availability of nitrogen in the substrate. This is because, the N participates in the roots due to the alteration of elongation rate and/or cell division, by hormones such as auxin, contributing to the final length of the roots (SOARES et al., 2016).

Andrade et al. (2012) using wastewater with a high percentage of organic matterin irrigation obtained higher potential total dry matter accumulation of varieties of ornamental sunflower: Night Sun, Red Sun, debilis Cream and EMBRAPA 122 V2000, results similar to those found in this study.

These results may be associated to the fact that with the addition of the organic residue, the organic matter, and consequently the activity humicssubstances increase in the substrate.In this sense, Baldotto e Baldotto (2015) in ornamental sunflower crop under field conditions due to humic substances (HSs), observed increment growth and yield of plants by increasing the dosage HSs.Zandonadi et al. (2013) stresses thatthe effects promoted byhumic substances in the growth regulation are similar to those of plant hormones,such as auxin, can significantly increase the production of lateral roots and absorbent hair.

Increasing the dose of cattle manure in the substrate linearly brought the number of petals, green and dry petals phytomass to the level of 1,096 (Figure 2A), 2,566 (Figure 2B) and 0.411 (Figure 2C). Respectively, per unit increase of the organic feedstock dose. By relating the values of 22.91, 8.47 and 1.25 to 33.87, 34.14 and 5.37, from low to high dose, it appears that the application of cattle manure increased in 47.8, 303.1 and 329.6 %, the average values of the number of petals, and green and dries petals biomass, respectively.

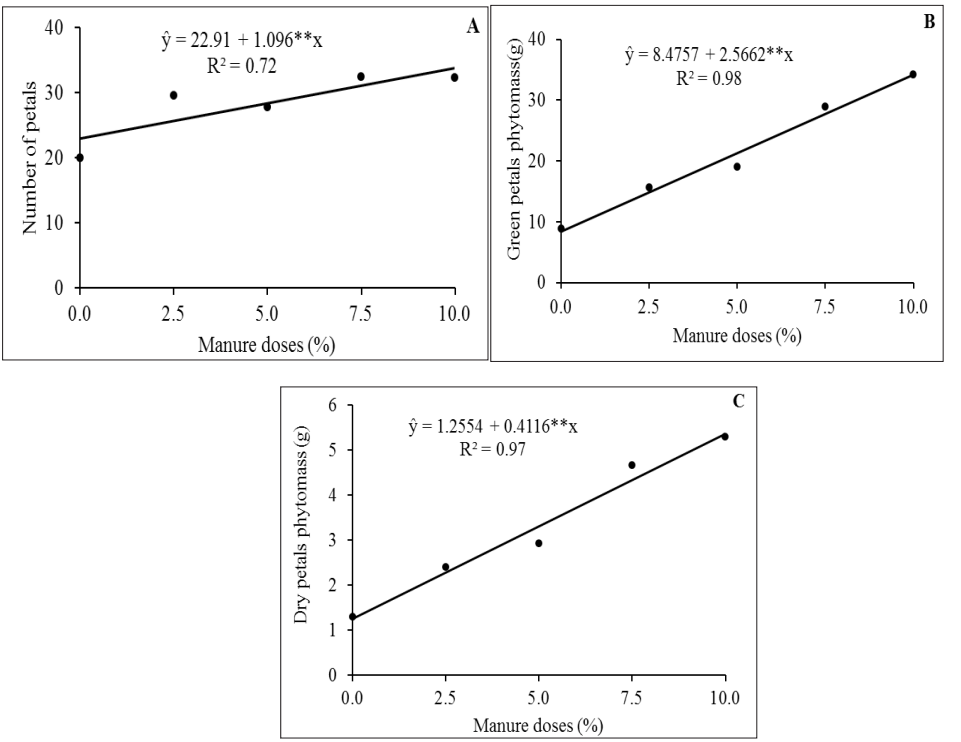

Figure 2. Number of petals (A), green petals phytomass (B) and dry petals phytomass (C) of Dwarf sunflower Garden, due to the addition of different dosages cattle manure.

The number of petals and phytomass are important variables when working with the production of flowers in view that a greater petals density increases plastic beauty, as well as providing more attractive by consumers. Superiority in phytomass possibly occurred due to the activity of organic matter. This is becausethrough the humic substances in the root environment, providing better conditions for the root system of plants(ZANDONADI *et al.*, 2014), hence higher growth, higher emission leaf number, provided greater photosynthetic area and greater biomass allocation (Campos *et al.*, 2015).

Wolf *et al*. (2007) studied the organic fertilization with sewage sludge in the production of dry sunflower matter, showed an increase in dry matter production of shoots with increasing doses of organic residue. Andrade *et al*. (2014) found that doses close to 15% of manure provides better growth of ornamental sunflower, re-

gardless of the type of water used in irrigation (supply or wastewater).

Andrade *et al*. (2012) studying the fertilization with cattle manure in the productive characteristics of ornamental sunflower, noted that the dose of 14.98% manure provided higher number of petals. Birth (2012) noted that cultivate sunflower 122/V-2000 responded linearly to the organic compost dosages applied to the soil where the highest dose (160 kg ha^{-1}) provided greater number of petals of the culture.

The ornamental sunflower plants obtained higher green phytomass chapter with petals without petals when fertilized with cattle manure 10 %, representing a superiority of 19.04 and 17.13 g, respectively compared to plants that did not receive cattle manure (Figure 3A and B). Similarly, for green petals biomass, the increase of cattle manure dose linearly raised dry phytomass of chapters with and without petals at the level of 0.34 and 0.32 per unit increase of the dose of the natural input, respectively (Figure 3C and D). These results can be explained by possible chemical and physical improvements in the substrate due to the addition of organic matter, providing, respectively, increased availability of nutrients associated with the higher water retention capacity of the soil, through the cementation of edaphic particles.

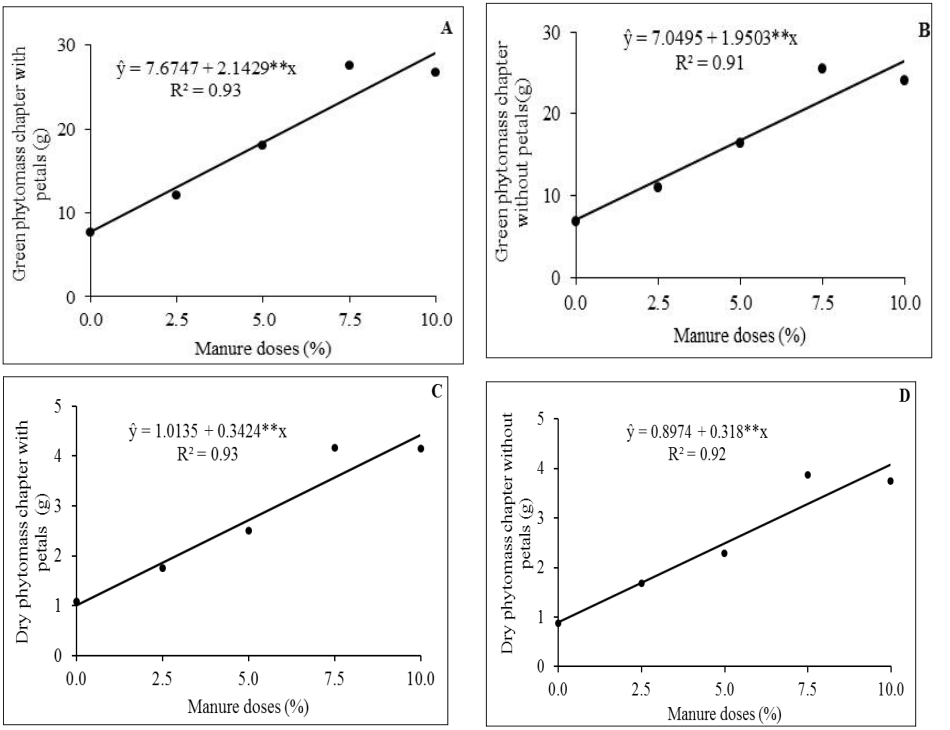

Figure 3. Green phytomass chapter with (A), without petals (B) and dry phytomass chapter with (C) and without petals (D) of Dwarf sunflower Garden, due to the addition of different dosages cattle manure.

Maia Filho *et al*. (2013) observed that the organic fertilization with cattle manure positively influenced the shoot phytomass of sunflower in the Paraiba Semi-arid. As well as, Noble *et al.* (2014) analyzing the sunflower growth, observed that the plants obtained linear increase in phytomass until a maximum dose of 2.5% of cattle manure in the total volume of the substrate.

Santos *et al*. (2013) found that the estimated maximum dose of 10.02 t ha-1 of manure resulted in increased chapter mass to the maximum weight of 98.81 g, which reflected in higher grain yield of the crop. These authors attribute this increase to the gradual availability of nutrients throughout the crop cycle by cattle manure, featuring marked effect in the chapter phytomass increases.

The capacity to availability of nutrients from the cattle manure, can contribute directly to the phytomass accumulation, because this macronutrient is present in

biomolecules composition, such as ATP, NADH, NADPH, chlorophyll, proteins and numerous enzymes (BREDEMEIER; MUNDSTOCK, 2000; EPSTEIN, 2004), favoring the stretching and cell division, resulting in carbon accumulation by the plants (TAIZ; ZEIGER, 2013).

It is observed in Figure 4A, the organic fertilization with cattle manure linearly reduced the average time from sowing to the appearance of the flower bud. By relating the values of 58.44 to 46.52, the substrate without and with the highest dose of cattle manure, is noted a percentage reduction of 20%. This result shows more rapid development of plants, resulting in time savings and producing labor with a view to greater precocity of plants.

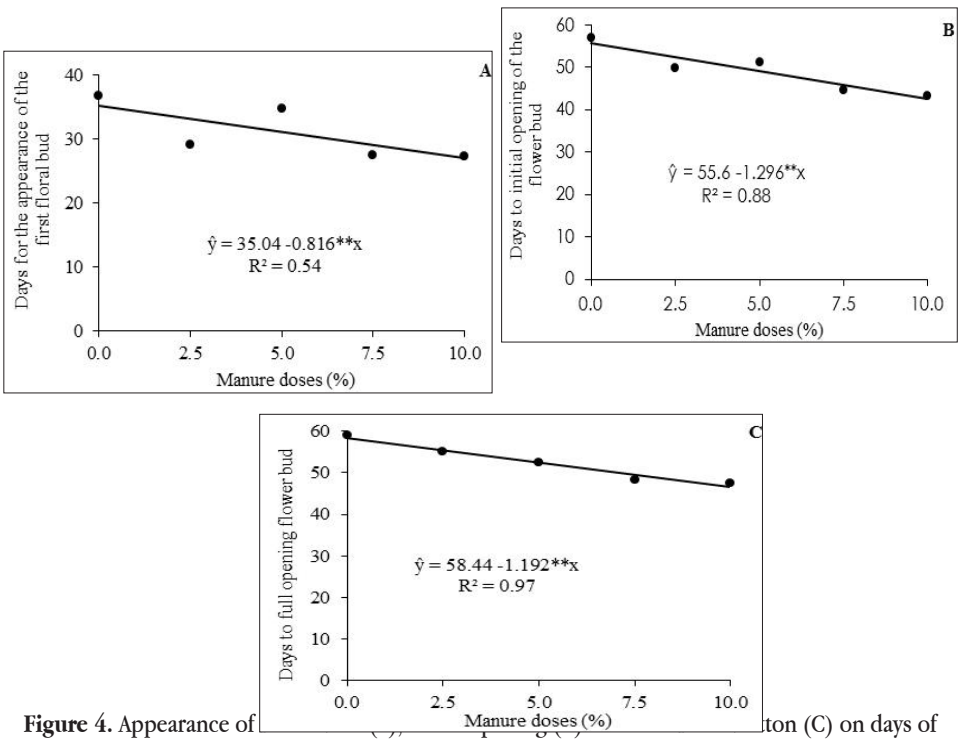

Figure 4. Appearance of [illegible] ton (C) on days of Dwarf Sunflower Garden, due to the addition of different dosages cattle manure.

The same trend was observed in the initial period, and complete opening of floral buds (Figure 4B and C, respectively), in which the dose 10% of manure provided greater precocity of plants, reducing these periods in 13.6 and 9.4 days, corresponding to an advance in the development of 24 and 25.6%, respectively.

Andrade *et al*. (2014) observed that doses above 7.24% manure in the substrate, enhances the appearance of the flower buds, reaching its peak when adding 20 % of the organic input in the edaphic environment. The authors also report that the dose of 8.41 % of manure led to the greatest reduction in days for the full opening of the flower bud.

Noble *et al.* (2010) studied the production of sunflower cv. Embrapa 122 V-2000 under different blades with domestic effluents and cattle manure, found a similar effect of this type of fertilization on the initial period of floral issue. Santos *et al*. (2015) observed that the organic fertilizer, obtained by aerobic composting of poultry slaughter waste provided better and higher growth of gerbera (*Gerbera jamesonii*) than mineral fertilizer, it can be used as an alternative source for nutrition of the culture pot.

The work is nice. Add a perspective of studies of organic waste with the species. What would be most interesting to rate?

4 CONCLUSIONS

The dose of cattle manure of 10 % of the substrate volumestimulates the production of petals, and fresh and dry mass of Dwarf Sunflower Garden;

The organic fertilizer with manure is an efficient alternative for fertilization of ornamental sunflower.

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