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Pruning of the main stem of Marigold: effect on capitula yield

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ABSTRACT

The purpose of this work was to evaluate the influence of cutting the apex of the main stem of marigold plants on floral capitula yield. The experiment was carried out in a randomized complete block design, with five replicates. The following removal stages of the main stem apexes were studied: control (without pruning), up to 10 leaves, up to 15 leaves and visible flower bud. Three harvest periods were also evaluated: July, August and September, composing a factorial experiment in a 4x3 arrangement. The diameter, number, fresh matter and the dry capitula were evaluated. The most significant effect of cutting the apex of the main stem on fresh and dry matter of the capitula was obtained when the technique was performed at the time the plants had up to 15 leaves and visible flower bud. The harvesting performed in September showed to be the most promising, since it presented the larger diameter, higher number and higher fresh matter and the dry capitula.

Keywords: *Calendula officinalis*, stem conduction, top pruning, management techniques.

RESUMO

Poda na haste principal em calêndula: efeito na produção de capítulos florais

O objetivo deste trabalho foi avaliar a influência da poda da haste principal de plantas de calêndula na produção de capítulos florais. O experimento foi conduzido em blocos casualizados, com cinco repetições. Foram estudados os seguintes estágios de supressão da haste principal: testemunha (sem poda), acima de 10 folhas, acima de 15 folhas e botão floral visível; também foram avaliadas três épocas de colheita: julho, agosto e setembro, constituindo o arranjo do experimento em esquema fatorial 4x3. Foram avaliados o diâmetro, o número, e a massa de matéria fresca e seca de capítulos. Houve efeito significativo da poda da haste principal na matéria fresca e seca de capítulos, quando realizada no momento em que a planta possui mais de 15 folhas e apresenta botão floral visível. A colheita no mês de setembro caracterizou-se como a mais adequada, pois apresentou o maior diâmetro, número, e massa de matéria fresca e seca de capítulos florais.

Palavras-chave: *Calendula officinalis*, condução de hastes, poda apical, técnicas de manejo.

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Grown as a cut flower for ornamental usage, for cooking, and especially because of its medicinal properties (Bertoni *et al*., 2006), marigold (*Calendula officinalis*) belongs to the Asteraceae family and has its origins in southern Europe (Gazim *et al*., 2008). Considering its medicinal properties the species receive a special interest for integrating both the primary productive system and the industry, but it must be taken into account that the phytochemical composition of the plant varies according to environmental, genetic and nutrition factors, as well as with harvesting conditions (Gobbo-Neto & Lopes, 2007).

Because it can be acclimatized to the Southern Brazilian regions and it can grow well in similar edaphic conditions (Bertoni *et al*., 2006), marigold has potential for exploitation in Rio Grande do Sul, Brazil, and can be indicated as an alternative in crop diversification for small farmers that use family labor. However, to increase the yield of the capitula and, consequently, the profitability of the culture, management techniques that enable increased production and the quality of the raw material must be used. In most plant species, the auxin production in the apical meristem promotes cellular elongation and, therefore, stimulates height growth. By inhibiting apical dominance, the stimulus of lateral buds and cytokinins production promote higher cell division and by that there is a rise on the number of side buds. Thus, the use of apical cutting or pruning is a common management technique in fruit, forest and some horticultural species in which, with the removal of the stem apex, an increase in branching is obtained and consequently the development and growth of those branches contribute to obtain a higher number of flowers (Taiz & Zeiger, 2013).

Considering the potential presented by this technique on several species, the purpose of this work was to study the influence of pruning the main stem of marigold plants in different stages of growth and its influence on the yield of capitula in different periods of the year.

MATERIAL AND METHODS

The experiment was carried

out at the experimental area of the Technological Innovation Pole of Alto Jacuí, located at the Campus University (28°38'19"S, 53°36'23''W, altitude 452 m). The climate of the region is subtropical, Cfa type, according to Köppen's classification, and the soil is classified as Dystrophic Red Oxisol according to Embrapa (2006). Through the analysis of soil samples of the 0 to 20 centimeters layer, the following contents were shown: 55% clay, pH in water: 4.6; organic matter: 3.1%; phosphorus: 6.3 mg/L; potassium: 181 mg/L; calcium: 2.8 cmolc/L; magnesium: 1.7 cmolc/L; aluminum: 0.2 cmolc/L; H+Al: 7.7 cmolc/L and base saturation: 38%.

The propagation of marigold was conducted by indirect seeding, using seeds from Bonina Sortida (Isla) cultivar. In March, 2013, three seeds were sown per alveolus in polystyrene trays of 128 alveoli, filled with commercial substrate Plantmax, which were kept under 50% shading and irrigated daily. After the emission of the first definitive pair of leaves, only one plant per alveolus was left.

The definitive land local was prepared in December, 2012, upon the setting-up of flower beds which had width of 1.20 meters and length of 2.50 meters, with total floor area of 2.59 m². As mulching, kid beans (*Vigna unguiculata*) and Sudan grass (*Sorghum sudanense*) were sown in consortium, with the density of 60,000 plants/ha and 40,000 plants/ha, respectively. In March, 2013, plants were cut using manual mower, with the plant material remaining as mulch.

The transplant of the seedlings with five to six definitive leaves was performed in April, with spacing of 0.50 meters between rows and 0.25 meters between plants. The fertilization was performed according to recommendations to the growing of marigold (Comissão..., 2004). Through the period of transplanting, 80 kg/ha of P_2O_5 in the form of single super phosphate and 50 kg/ha of nitrogen fertilizer in the form of urea were applied. The use of 2.1 t/ha of dolomitic lime with PRNT (Relative Total Neutralization Power) of 90% occurred in coverage, to raise the levels of pH in water to 5.5 (SMP method). The manual control of weeds happened through hoeing. There was no need of pests and diseases control.

The design of the experiment was of randomized complete blocks, with five replicates, in a factorial scheme of 4x3. Levels of factor "A" consisted in different stages of cutting of the main stem [control (without pruning), up to 10 leaves, up to 15 leaves and visible flower bud] and the levels of factor "B" consisted of three harvest periods (July, August and September). The plots were composed of 25 plants on which ten plants were considered as the useful area. To determine the time of pruning, the leaves were counted from the base of the plant towards the apex of the main stem. The average diameter, the number of capitula per plant and the total fresh and dry matter of the capitula were evaluated.

The diameter was measured with the aid of a millimeter ruler. To determine the fresh and dry weight, the capitula were collected and weighed when completely open, wherein, in July, August and September 5, 6 and 8 harvests were accomplished, respectively. In each month, the harvests were added up for analysis. Next, the capitula were packed in paper bags and taken to a drying oven with forced air ventilation with temperature of 65°C, until achieve constant weight to determine the dry matter. The weighing was made in a digital scale accurate to 0.001 grams.

The data were transformed in the square root of X+0.5, submitted to analysis of variance and the averages were compared by the Scott-Knott test, 5% probability, with the assistance of statistical package (Sisvar, v. 5.3) (Ferreira, 2011).

RESULTS AND DISCUSSION

For all evaluated variables there was no interaction between the different stages of pruning of the main stem and the three harvest periods. The diameter and number of capitula were not affected by the different stages of pruning (Table 1). This result highlights that the utilization of pruning the main stem does not interfere in the emission of capitula neither on its diameter. However, differences were observed between the levels of factor "A" to the variables fresh and dry matter capitula, wherein both showed an increase when the pruning was realized after the emission of the 15th leaf and also when the flower bud was visible. This result is uneven when observed by Garde *et al*. (2013) in cultivation of potted Chrysanthemum with different pruning dates, in which the authors reported the occurrence of reduction of the inflorescences dry matter per pot with the increased gap between the staking and the pruning.

The higher increase of fresh matter and dry capitula happened during August and September (Table 2), which confirms the affirmation of Lorenzi & Matos (2008), who describe that this is the preferred flowering time of the species, that is, during winter/spring. The yield during August (1,664.8 and 2,107.2 kg/ha) and September (301.6 and 310.4 kg/ha) for dry matter and fresh capitula, respectively, were similar to the results found by Vieira *et al*. (1999) during August and higher in September. Researching different types of fertilization, the authors verified yield of 1,794.64 kg/ha and 240.96 kg/ha for fresh matter and dry capitula of marigold, when used 14 t/ha of chicken manure and absence of P_2O_5.

The capitula's diameter was greater when harvested during August and September. Scalon Filho *et al*. (2011) verified the higher values for diameter of capitula 105 days after the transplant, decreasing thereafter, and a linear increase of capitula number in marigold until 126 days after the transplant, similar to the harvest period correspondent to the month August of this study. However, in this study, a significant decrease on capitula diameter values was not observed until the last harvest period. A greater increment of capitula was observed during the harvest period of September (144 to 169 days after the transplant), with an average of 10.54 capitula per plant (Table 2). The management technique using the

Table 1. Diameter, number of capitula, total fresh and dry matter of capitula of marigold in different stages of apical pruning. Cruz Alta, UNICRUZ, 2013.

Pruning	Diameter (cm)	Capitula (nº/plant)	Fresh matter (kg/ha)	Dry matter (kg/ha)
Control	6.25* a	6.97 a	1628.8 b	271.2 b
Up to 10 leaves	5.92 a	8.17 a	1500.0 b	232.8 b
Up to 15 leaves	6.72 a	7.84 a	1977.6 a	342.4 a
visible flower bud	6.29 a	8.77 a	2035.2 a	328.0 a
CV (%)	21.92	41.48	40.48	38.40

*Averages followed by same letters in the column do not differ by the Scott-Knott test, 5% probability.

Table 2. Diameter, number of capitula, total fresh and dry matter of capitula of marigold in different harvest periods. Cruz Alta, UNICRUZ, 2013.

Harvest period	Diameter (cm)	Capitula (nº/plant)	Fresh matter (kg/ha)	Dry matter (kg/ha)
July	5.18* b	4.51 c	1324.0 b	247.2 b
August	6.88 a	6.75 b	1664.8 a	301.6 a
September	6.41 a	10.54 a	2107.2 a	310.4 a
CV (%)	18.97	38.04	38.59	33.03

*Averages followed by same letters in the column do not differ by the Scott-Knott test, 5% probability. ; ; ;

pruning of the apex in stages of up 15 leaves and or in the presence of a visible flower bud may contribute to the increased yield per area unit. Under the conditions this work was carried out, we concluded that for achieving greater fresh matter and dry capitula of marigold, it should be opted to do the pruning of the main stem after the issuance of the 15th leaf and/or the first visible bud. Additionally, it appears that September is the most suitable period for the largest increase on number of formed capitula.

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REFERENCES

BERTONI, BW; DAMIÃO FILHO, CF; MORO, JR; FRANÇA, SC; PEREIRA, AMS. 2006. Micropropagação de *Calendula officinalis* L. *Revista Brasileira de Plantas Medicinais* 8: 48-54.

COMISSÃO DE QUÍMICA E FERTILIDADE DO SOLO. 2004. *Manual de adubação e calagem para os Estados do Rio Grande do Sul e de Santa Catarina.* Porto Alegre. 391p.

EMBRAPA. 2006. *Sistema Brasileiro de Classificação de Solo.* Rio de Janeiro: EMBRAPA. 306p.

FERREIRA, DF. 2011. Sisvar: a computer statistical analysis system. *Ciência & Agrotecnologia* 35: 1039-1042.

GARDE, GP; MUNIZ, MA; PÊGO, RG; GROSSI, JAS. 2013. Data de desponte apical e intensidade luminosa no crescimento e qualidade de crisântemo de vaso. *Horticultura Brasileira* 31: 659-663.

GAZIM, ZC; REZENDE, CM; FRAGA, SR; SVIDZINSKI, TIE; CORTEZ, DAG. 2008. Antifungal activity of the essential oil from *Calendula officinalis L.* (Asteraceae) growing in Brazil. *Brazilian Journal of Microbiology* 39: 61-63.

GOBBO-NETO, L; LOPES, NP. 2007. Plantas medicinais: fatores de influência no conteúdo de metabolitos secundários. *Química Nova* 30: 374-381.

LORENZI, H; MATOS, FJA. 2008. *Plantas medicinais no Brasil: Nativas e Exóticas cultivadas.* Nova Odessa: Instituto Plantarum. 576p.

SCALON FILHO, H; VIEIRA, MC; SCALON, SPQ; HEREDIA, NAZ. 2011. Formas de aplicação de cama-de-frango no crescimento e produção de capítulos florais de *Calendula officinalis* L. *Revista brasileira de plantas medicinais* 13: 382-388.

TAIZ, L; ZEIGER, E. 2013. *Fisiologia Vegetal*. Porto Alegre: ArtMed. 954p.

VIEIRA, MC; HEREDIA ZÁRATE, NA; AMORIM PQ. 1999. Crescimento e produção de capítulos de *Calendula officinalis* L., em função de cama-de-aviário semi-decomposta e de fósforo. *Revista Brasileira de Plantas Medicinais* 1: 45-51