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Vegetative and flowering characters in African marigold (*Tagetes erecta* L.) cultivars under Rayalaseema conditions

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Abstract
The experiment "Evaluation of African marigold (*Tagetes erecta* L.) cultivars under Rayalaseema region of Andhra Pradesh" was carried out to assess eleven different cultivars, including specific types of African marigold, under Rayalaseema's agro-climatic conditions. The performance of these cultivars was observed in terms of both vegetative and flowering attributes. The experiment followed a Randomized Block Design with 11 cultivars, each replicated three times.
The results showed that cultivars Orange Glory, Tennis Ball Plus, and Astagandha Plus exhibited better performance in terms of vegetative growth parameters among the cultivars. Siri had the highest fresh weight, dry weight, and flower diameter which was followed by Astagandha Plus. Additionally, Orange Glory displayed the maximum number of flowers per plant.

Keywords: African marigold, *Tagetes erecta*, vegetative attributes and flowering attributes

Introduction
Marigold held a significant position as a popular loose flower, esteemed for its remarkable beauty, vibrant color spectrum encompassing shades like white, creamy yellow, golden yellow, and various hues of orange. Its diverse array of sizes, shapes, forms, and fragrances contributed to its allure. Over the past thirty years, changing lifestyles and increasing urban incomes have emphasized the social and economic aspects of floriculture. The shift towards high-value cash crops, such as flowers, has proven more advantageous for farmers compared to traditional crops. However, factors like marketing, post-harvest management, and value addition play a pivotal role in determining farmers' livelihood prospects. The demand for marigold varieties that exhibit uniform growth, moderate compactness, and brightly hued flowers with extended shelf life is substantial (Bharathi *et al*., 2014) [2].
Marigold stands as a prominent commercial flower, finding utility in crafting garlands for religious and social events, as well as for bedding and potted plants. With their vibrant hues, these blooms are cost-effective options for various gardening applications, including edging and hanging baskets. They infuse gardens with shades of gold, copper, and brass throughout the summer and fall seasons. Beyond its role in commercial floriculture, marigold's versatility extends to several potential applications in medical and industrial domains.
Notably, a cultivar that thrives in one location might not flourish in another region with differing climatic conditions (Naik *et al*., 2019) [11]. Often, farmers opt for local cultivars without fully considering production and quality potential, despite the existence of numerous cultivars with superior production capacity and enhanced quality traits introduced in various states. An understanding of the performance of distinct germplasm accessions assumes significance for successful cultivation. It is prudent to recommend and commercially cultivate only those germplasm varieties that demonstrate superior adaptation to specific regions.
Hence, the evaluation of marigold germplasm assumes vital importance, as it aids in identifying cultivars with desirable quality attributes that can be recommended to farmers for harnessing their potential. Given the dynamic nature of the environment and rapid innovations in the floriculture sector, such assessments are crucial. These considerations framed the backdrop of the present study, which aimed to identify an exceptional African marigold cultivar suited for the Rayalaseema region of Andhra Pradesh.

Material and Methods

The study was conducted under open field environmental conditions during the kharif season at Dr. YSRHU - College of Horticulture, Anantharajupeta, Annamayya district, Andhra Pradesh in the year 2022-23. The research encompassed the assessment of 11 distinct cultivars, including a reference variety, of African marigold. These cultivars were Pusa Basanti Gainda, Pusa Narangi Gainda, Bidhan Marigold-2, Orange Glory, Siri, Ashtagandha Plus, Tennis Ball Plus, Pooja, Dimpal, Mydukur Local, and Chitvel Local. The experimental layout adhered to a Randomized Block Design, with each cultivar being replicated three times.

Observations were made on various attributes, including plant height, plant spread, number of primary branches per plant, stem girth, fresh weight of flowers, dry weight of flowers, flower diameter, and number of flowers per plant. To facilitate this, five plants were randomly chosen from each replication for data collection.

Results and Discussion

As depicted in Table 1 and Table 2, significant variations existed among the 11 African marigold cultivars with regards to both vegetative and flowering characteristics.

Vegetative characters

Among the cultivars, Tennis Ball Plus demonstrated the highest plant height (104.34 cm) and plant spread (56.17 cm), followed by Orange Glory (93.03 cm) in terms of plant height and Bidhan Marigold-2 (54.40 cm) in terms of plant spread. Conversely, the lowest measurements were noted in the Dimpal variety (65.40 cm for plant height and 34.57 cm for plant spread) at 90 days after transplanting (DAT).

Regarding primary branches per plant, Orange Glory exhibited the highest count (19.03), accompanied by a substantial stem girth (6.60 cm). Tennis Ball Plus followed closely with 17.70 primary branches, while Astagandha Plus registered a stem girth of 6.18 cm. The lowest values were observed in the Dimpal cultivar (8.90 primary branches and 3.56 cm stem girth) at 90 DAT.

The differences in plant height, plant spread, number of primary branches per plant, and stem girth count among the cultivars were attributed to their genomic sequences, as these traits are inherently linked to specific cultivars. The differences among cultivars could arise because the environment provided a favorable setting for the dominant genes to be expressed. The distinct genetic compositions of individual cultivars, coupled with their interactions with the environment, gave rise to these fluctuations in plant height, spread, and primary branches per plant. Factors such as cell division and expansion, water absorption and retention, nutrient availability, hormonal equilibrium, and environmental conditions encompassing light intensity and temperature played pivotal roles in driving the growth of stem girth in plants. Similar findings were observed by Deepa and Patil (2016) [5], Mahantesh *et al.* (2018) [10] and Shilpa *et al.* (2022) [12].

Flowering characters

The cultivar Siri recorded the highest fresh weight and dry weight for a flower (13.26 g and 2.39 g, respectively), followed by Astagandha Plus (10.05 g and 1.81 g). Conversely, Dimpal exhibited the lowest values (5.50 g for fresh weight and 0.88 g for dry weight). Siri also attained the maximum flower diameter (7.89 cm), which was on par with Astagandha Plus (7.76 cm), Tennis Ball Plus (7.51 cm), and Orange Glory (7.39 cm). On the other hand, Dimpal displayed the smallest flower diameter (3.43 cm). In terms of the number of flowers per plant, Orange Glory excelled with the highest count (83.20), followed by Tennis Ball Plus (73.25). Dimpal had the fewest flowers per plant (29.39) among the 11 African marigold cultivars.

Differences in flower weight across various genotypes could have been influenced by genetic variations, flower size, or the number of flower petals (Patokar *et al*., 2018) [14]. The presence of water is essential to uphold the firmness and vitality of flowers. The collective impact of these factors contributes to an increase in flower weight. Variations in flower dry weight may have been prompted by the innate traits of each variety, possibly influenced by both flower fresh weight and diameter. The disparity observed in flower dry weight could be attributed to the inherent characteristics of individual varieties and the interplay with flower fresh weight and diameter. This variation could be associated with a combination of genetic attributes and environmental factors. The findings match up with the conclusions of Kumar *et al.* (2015) [8] and Gulia *et al.* (2017) [6].

The genetic composition of the cultivar and the higher leaf count, which could have resulted in increased dry matter accumulation and greater photosynthate production, might have played a role in the generation of larger flowers. This connection could have contributed to the observed variations in flower diameter (Gupta *et al.*, 2017) [7]. Similar findings have been reported by Lohar *et al.* (2018) [9]. These findings are in line with Naik *et al.* (2019) [11] and Beniwal and Sheoran (2022) [1].

The potential for variation might have arisen due to the genetic traits inherent in the cultivar. The presence of a greater or lesser number of branches could have accounted for these differences. The plant's phenotypic efficiency possibly played a pivotal role by enhancing nutrient accumulation, thereby stimulating plant growth and augmenting flower yield. These findings are in line with Thirumalmurugan *et al.* (2020) [13], Bhusaraddi *et al.* (2022) [4] and Bhusal *et al.* (2023) [3].

Table 1: Vegetative characteristics of African marigold cultivars under Rayalaseema conditions

Cultivars	Plant height (cm) at 90 DAT	Plant spread (cm) at 90 DAT	Number of primary branches at 90 DAT	Stem girth (cm) at 90 DAT
T_1 - Pusa Basanti Gainda	84.00^{cd}	48.54^{ab}	11.96^{cd}	5.69^{abc}
T_2 - Pusa Narangi Gainda	80.42^{cd}	47.99^{b}	12.87^{c}	6.10^{ab}
T_3 - Bidhan Marigold - 2	78.24^{d}	54.40^{ab}	16.60^{b}	5.66^{abc}
T_4 - Orange Glory	93.03^{b}	52.30^{ab}	19.03^{a}	6.60^{a}
T_5 – Siri	87.61^{bc}	47.33^{b}	16.47^{b}	5.10^{bcd}
T_6 - Tennis Ball Plus	104.34^{a}	56.17^{a}	17.70^{ab}	6.16^{a}
T_7 - Astagandha Plus	87.69^{bc}	47.01^{b}	16.73^{b}	6.18^{a}

T_8 – Pooja	75.95^{de}	42.97^{b}	10.50^{de}	4.49^{def}
T_9 – Dimpal	65.40^{f}	34.57^{c}	8.90^{e}	3.56^{f}
T_{10} - Mydukur Local	68.86^{ef}	37.26^{c}	9.70^{e}	3.91^{ef}
T_{11} - Chitvel Local	76.86^{de}	43.50^{b}	10.93^{cde}	4.72^{cde}
Mean	**82.04**	**46.54**	**13.76**	**5.29**
S. Em±	2.99	2.61	0.73	0.35
CD at 5%	8.83	7.71	2.17	1.03

Table 2: Flowering characteristics of African marigold cultivars under Rayalaseema conditions

Cultivars	Fresh weight of a flower	Dry weight of a flower	Diameter of a flower	Number of flowers per plant
T_1 - Pusa Basanti Gainda	9.37^{bc}	1.59^{b}	6.94^{cde}	39.50^{def}
T_2 - Pusa Narangi Gainda	8.89^{bc}	1.51^{b}	6.45^{def}	36.46^{ef}
T_3 - Bidhan Marigold - 2	8.46^{c}	1.44^{b}	7.10^{bcd}	44.63^{cd}
T_4 - Orange Glory	8.91^{bc}	1.51^{b}	7.39^{abc}	83.20^{a}
T_5 – Siri	13.26^{a}	2.39^{a}	7.89^{a}	42.81^{cde}
T_6 - Tennis Ball Plus	9.16^{bc}	1.56^{b}	7.51^{abc}	73.25^{b}
T_7 - Astagandha Plus	10.05^{b}	1.81^{b}	7.76^{ab}	47.54^{c}
T_8 – Pooja	8.77^{bc}	1.49^{b}	6.18^{f}	34.98^{fg}
T_9 – Dimpal	5.50^{d}	0.88^{c}	3.43^{h}	29.39^{g}
T_{10} - Mydukur Local	6.12^{d}	0.98^{c}	4.29^{g}	29.99^{g}
T_{11} - Chitvel Local	9.89^{bc}	1.78^{b}	6.32^{ef}	29.91^{g}
Mean	8.94	1.54	6.48	44.70
S. Em±	0.49	0.14	0.23	2.19
CD at 5%	1.45	0.40	0.69	6.45

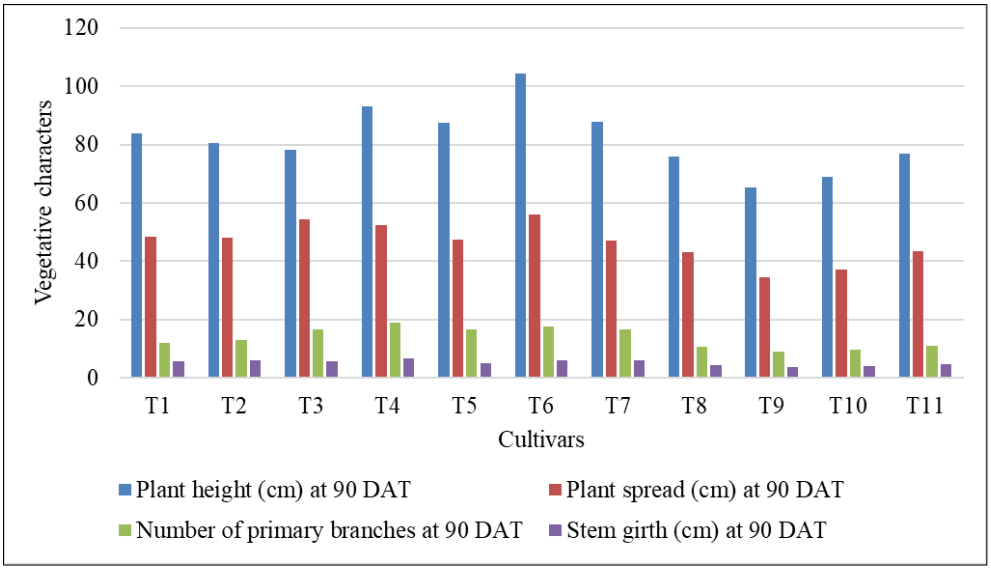

Fig 1: Vegetative characteristics of African marigold cultivars under Rayalaseema conditions

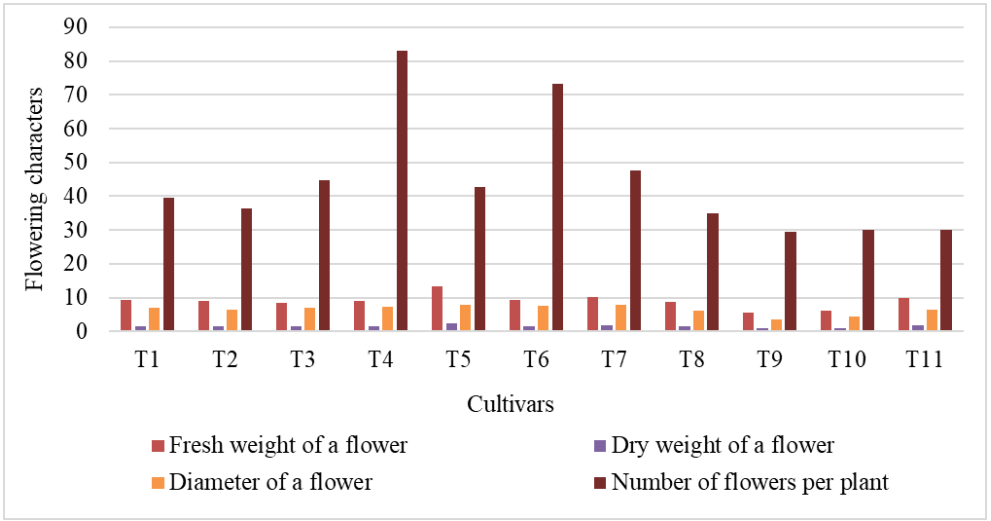

Fig 2: Flowering characteristics of African marigold cultivars under Rayalaseema conditions

Conclusions

In the current study, notable variations were observed among the different varieties, offering substantial potential for optimal utilization in loose flower cultivation. Drawing insights from the study outcomes, it is conceivable to assert that the African marigold variety "Orange Glory" emerged as the most fitting choice for successful commercial production. This selection is likely to yield a prosperous outcome in terms of loose flower production within the context of the Rayalaseema region of Andhra Pradesh.

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