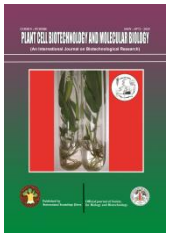

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Effect of Different Planting Dates on Tuber Production in Dahlia (*Dahlia variabilis* L.) in Low Hill Conditions of Himachal Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. Authors MK, PT, BK, PK and AS were involved in the conception and design of the experiments. Author MK fieldwork and data collection were conducted. Authors MK, PT and AS performed the data analysis. Author RB also helped in writing the research paper. Authors BK, PK, AS, RB, NK and AHS provided critical revisions. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The research, entitled " Effect of different planting dates on tuber production in dahlia (*Dahlia variabilis* L.) in low hill conditions of Himachal Pradesh" was carried out at RHRTS Dhaulakuan, Ponta Sahib (HP). The study aimed to investigate the impact of different planting dates on tuber production in five dahlia cultivars (Anarkali, Gargi, Giani Zail Singh, Matungini and Suryadev) in low hill. Three planting dates (September 15th, October 15th and November 15th) were chosen for evaluating vegetative parameters. Plant height (109.61 cm) and internodal length (10.34 cm) both were found to be optimal in the cultivar Suryadev. Furthermore, the cultivar Matungini exhibited the highest plant spread (42.72 cm). In terms of tuber production, Anarkali demonstrated superior performance in tuber weight (368.90 g), and tuber yield per plot (2.00 kg). Conversely, Matungini excelled in the number of tubers per plant (4.69), tuber length (13.24 cm) and tuber diameter (30.25 mm), while Giani Zail Singh showcased the best tuber diameter. The planting date of October 15th was identified as highly suitable for optimal tuber production across all parameters under low hill climatic conditions.

Keywords: Cultivars; dahlia; planting date; tuber production; tuber weight.

ABBREVIATIONS

cm : Centimetre
G : Gram
Kg : Kilo gram
Mm : Millimetre
% : Percent
L : Liter
FYM : Farmyard Manure
NPK : Nitrogen, Phosphorus and Potassium

1. INTRODUCTION

The dahlia scientifically known as *Dahlia variabilis* L., is indigenous to Mexico and is recognized as the national flower of the country. It is classified under the family Asteraceae, subfamily Asteroideae and order Asterales [1]. Dahlias as depicted in a sonnet by Geeta Radhakrishna Menon, represent hope, confidence and flamboyance, emitting a lively and joyous atmosphere. Dahlias are highly prized in landscaping for their stunning and appealing flowers. They are one of the most popular half-hardy perennials with tuberous roots. Dahlias often have compound leaves that are divided and serrated or incised. The dahlia is revered as the "king of flowers" due to its beauty and is commonly used in bedding, exhibitions, garden displays and interior decorations [2]. The Dahlia plant was first introduced to India in 1857 at the Agri-horticultural Society of India in Kolkata. The flowers exhibit a wide range of color combinations, such as white, yellow, orange, red, pink and purple. The flowers come in varied diameters from 5 cm to 30 cm. Multiple groups are available, each with unique characteristics such as pompom, Anemone, Miniature, Decorative and Cactus Dahlias etc. Dahlia plants vary in height, ranging from 40 to 180 cm, depending on the unique cultivar. Dahlias hybrid nature indicates its complex ancestry [3]. The abundant blooming and simple cultivation of Dahlias, whether in pots or in the ground, have led to their widespread popularity. Dahlias have nutritional and therapeutic advantages in addition to being attractive. The tubers are high in inulin and fructose and also contain tiny amounts of medicinal substances including phytin and benzoic acid [4]. Dahlia seeds contain a protein level of more than 16% and a fat content that varies from 20.9% to 47.1%. The Netherlands is a significant contributor to the production of tuberous-rooted Dahlias, sending 50 million Dahlia tubers to global markets each year [5-8]. This emphasizes the significant worldwide influence of cultivating Dahlias. The current investigation aimed to assess the impact of planting dates on tuber production in different cultivars of dahlia under low hill conditions.

2. MATERIALS AND METHODS

The current study, titled "Effect of different planting dates on tuber production in dahlia (*Dahlia variabilis* L.) in low hill conditions of

Himachal Pradesh," was conducted at RHRTS Dhaulakuan, Ponta Sahib, Department of Floriculture and Landscape Architecture, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, from 2021 to 2023. The study assessed the effect of different planting dates on tuber production in five Dahlia cultivars: Anarkali, Gargi, Giani Zail Singh, Matungini, and Suryadev, in low hill conditions.

Three specific planting dates were selected: September 15th, October 15th and November 15th creating a total of 15 treatment combinations (5 cultivars × 3 planting dates). Rooted cuttings were planted in the field at a spacing of 45 cm × 45 cm. The study utilized a Randomized Block Design (RBD) with a factorial layout to thoroughly evaluate the interactions between cultivars and planting dates. Three replications were conducted for each treatment to ensure statistical robustness, yielding a total of 45 experimental plots. Each plot had nine plants, creating a significant dataset for studying how different Dahlia cultivars respond in tuber development to varied planting dates in low hill environments.

This experimental design aimed to optimize tuber output in Dahlia cultivation by examining the impact of cultivar selection and planting date. Cuttings were treated with fungicide (Carbendazim 12% and Mancozeb 63% WP) at 1.5 gm/L, and transplanted cuttings were irrigated immediately in the morning and evening for 4-5 days. Once the cuttings were established, flood irrigation was done weekly and adjusted according to plant requirements and climatic conditions. Before transplanting, 5 kg of FYM was applied per square meter and 100:120:100 kg per hectare of NPK was applied. Half dose of the nitrogen was applied as a basal dose. The remaining 50% of the nitrogen dose was given in two parts: the first after one month and the second after two months. The full dose of phosphorus and potassium was given one month after transplanting.

3. RESULTS AND DISCUSSION

Analysing the Table 1. shows unique differences in plant traits among various cultivars and months. The plant reached a maximum height of (74.77 cm) when cuttings were transplanted on November 15th and a minimum height of (59.85 cm) when transplanted on December 15th. Suryadev had the maximum plant height (109.61 cm), while Gargi had the shortest (52.17 cm) among the cultivars. An interaction effect between the month and cultivars showed that the maximum plant height of (123.37 cm) was recorded when cuttings were transplanted on November 15th for the Suryadev cultivar, while the shortest height of (46.13 cm) was observed in December 15th transplanting for the Gargi cultivar.

The plant reached its widest spread when cuttings were transplanted on November 15th (41.53 cm) and its narrowest spread in December 15th transplanting (37.09 cm). Matungini had the widest plant spread (42.72 cm) among the cultivars, while Giani Zail Singh had the narrowest (36.66 cm). An interaction effect between the month and cultivars showed that the maximum plant spread occurred in November 15th transplanting, with Matungini reached (43.45 cm), while the narrowest plant spread was seen in case of December 15th transplanting for Giani Zail Singh at (33.93 cm).

The maximum internodal length (9.97 cm) was attained in November 15th transplanting, while the minimum (9.21 cm) was found in December 15th transplanting. Suryadev had the longest internodal length (10.34 cm), while Giani Zail Singh had the shortest (9.00 cm) among the cultivars. An interaction effect between the month and cultivars showed that the longest internodal length (10.66 cm) was observed on October 15th for the Suryadev cultivar, while the shortest internodal length (8.41 cm) was reported on December 15th for the Giani Zail Singh cultivar.

The variation in plant height, spread and internodal length among cultivars indicates a possible impact of both genetic traits and environmental conditions. The complex interaction of these elements could have either boosted or impeded the function of natural plant hormones in the stems, therefore influencing the observed differences. Ajeet et al. [9] have previously documented such discrepancies, emphasizing the intricate interplay between genetic composition and environmental factors in influencing plant characteristics. This highlights the necessity for additional research on the distinct genetic and environmental elements that influence the variations seen among cultivars, offering vital knowledge for farming techniques and crop enhancement plans. Similar results reported by Basakaran et al. [10] in chrysanthemum, Raghuvanshi et al. [11] in marigold and Hussain and Khan [12] in rose.

Table 1. Effect of planting dates on morphological traits of different dahlia cultivars in different months under low hill conditions

Years	Plant height (cm)			Mean	Plant spread(cm)			Mean	Internodal length(cm)			Mean
Months / Cultivars	15th Oct	15th Nov	15th Dec		15th Oct	15th Nov	15th Dec		15th Oct	15th Nov	15th Dec	
Anarkali	68.84^{b}	80.56^{a}	59.07^{c}	69.49^{b}	37.66^{b}	41.51^{a}	36.98^{b}	38.72^{cd}	9.76^{a}	9.58^{a}	9.17^{a}	9.51^{ab}
Gargi	54.53^{ab}	55.86^{a}	46.13^{b}	52.17^{e}	39.18^{b}	42.89^{a}	36.05^{b}	39.37^{bc}	9.08^{a}	9.59^{a}	8.98^{a}	9.22^{ab}
Giani Zail Singh	58.79^{ab}	62.79^{a}	53.78^{b}	58.45^{c}	38.54^{a}	37.52^{ab}	33.93^{b}	36.66^{d}	8.61^{b}	9.99^{a}	8.41^{ab}	9.00^{b}
Matungini	49.75^{a}	51.29^{a}	47.08^{a}	49.37^{d}	43.28^{a}	43.45^{a}	41.44^{a}	42.72^{a}	9.58^{a}	10.08^{a}	9.24^{a}	9.63^{ab}
Suryadev	112.46^{b}	123.37^{a}	93.01^{c}	109.61^{a}	44.56^{a}	42.26^{a}	36.83^{b}	41.22^{b}	10.66^{a}	10.62^{a}	9.74^{a}	10.34^{a}
Mean	68.88^{b}	74.77^{a}	59.85^{c}	-	40.64^{b}	41.53^{a}	37.09^{c}	-	9.44^{ab}	9.97^{a}	9.21^{b}	-

Table 2. Effect of planting dates on tuber production of different dahlia cultivars in different months under low hill conditions

Years	Number of tubers per plant			Mean	Dia meter of tuber (mm)			mean	Length of tubers (cm)			mean
Months / Cultivars	15th Oct	15th Nov	15th Dec		15th Oct	15th Nov	15th Dec		15th Oct	15th Nov	15th Dec	
Anarkali	5.00^{a}	4.94^{a}	2.60^{b}	4.18^{a}	29.77^{a}	24.37^{a}	17.59^{a}	23.91^{b}	18.63^{a}	14.27^{a}	5.19^{b}	12.70^{b}
Gargi	4.93^{a}	4.80^{a}	2.77^{b}	4.17^{a}	32.82^{c}	25.79^{b}	20.85^{b}	26.49^{b}	17.87^{a}	13.96^{b}	4.90^{c}	12.24^{b}
Giani Zail Singh	5.44^{a}	4.64^{a}	2.60^{b}	4.22^{b}	38.64^{a}	30.62^{a}	21.48^{a}	30.25^{a}	16.33^{a}	13.60^{b}	4.35^{c}	11.43^{a}
Matungini	5.77^{a}	5.34^{a}	2.97^{b}	4.69^{a}	33.41^{b}	26.01^{b}	21.20^{b}	26.87^{b}	19.08^{a}	14.95^{b}	5.69^{c}	13.24^{b}
Suryadev	4.63^{a}	4.43^{a}	2.27^{b}	3.78^{a}	31.98^{b}	24.96^{b}	19.42^{b}	25.45^{b}	16.63^{a}	13.82^{a}	4.84^{b}	11.76^{b}
Mean	5.15^{a}	4.83^{b}	2.64^{c}	-	33.32^{a}	26.35^{b}	20.11^{c}	-	17.71^{a}	14.12^{b}	4.99^{c}	-

Table 3. Effect of planting dates on tuber production of different dahlia cultivars in different months under low hill conditions

Years	Weight of tuber per plant			Mean	Tuber yield per plot (g)			Mean	Tuber yield per plot (Kg)			Mean
Months / Cultivars	15th Oct	15th Nov	15th Dec		15th Oct	15th Nov	15th Dec		15th Oct	15th Nov	15th Dec	
Anarkali	728.15[a]	302.83[a]	75.71[c]	368.90[a]	3,988.67[a]	1,643.50[b]	380.00[c]	2,004.06[a]	3.99[a]	1.64[a]	0.38[c]	2.00 [a]
Gargi	451.78[a]	196.15[b]	51.83[c]	233.25[d]	2,479.67[a]	1,182.50[b]	271.34[c]	1,311.17[b]	2.48[a]	1.09[b]	0.27[b]	1.28[c]
Giani Zail Singh	554.95[a]	251.96[b]	57.52[c]	288.15[b]	2,977.50[a]	1,466.67[b]	345.00[c]	1,596.39[b]	2.98[a]	1.42[b]	0.33[c]	1.57[b]
Matungini	502.44[a]	244.98[b]	54.36[b]	267.26[cd]	2,711.50[a]	1,320.34[a]	291.17[b]	1,441.00[c]	2.70[a]	1.37[b]	0.30[c]	1.46[b]
Suryadev	358.32[a]	175.74[b]	33.10[c]	189.06[bc]	1991.84[a]	1,137.33[b]	124.32[c]	1,084.50[c]	1.99[a]	1.01[b]	0.12[c]	1.04[c]
Mean	519.13[a]	234.33[b]	54.50[c]	-	2,829.83[a]	1,350.07[b]	282.36[c]	-	2.83[a]	1.30[b]	0.28[c]	-

Fig. 1. Tuber's production of different cultivars of dahlia

Studying Tables 2 and 3 shows clear differences in plant characteristics among various cultivars and months. The plant yielded maximum number of tubers per plant when transplanted on October 15th (5.15) and minimum (2.64) in case of December 15th transplanting. Matungini had the maximum number of tubers per plant (4.69), while Suryadev had the lowest (3.78) among all the cultivars. The interaction between months and cultivars showed that Matungini had the highest number of tubers per plant (5.77) in October 15th transplanting while Suryadev had the lowest (2.27) in December 15th transplanting.

The plant achieved its maximum tuber diameter (33.32 mm) when transplanting was done on October 15th, in contrast to minimum diameter (20.11 mm) obtained in plants transplanted on December 15th. Giani Zail Singh recorded the highest tuber diameter (30.25 mm) while Anarkali attained the smallest (23.91 mm). Giani Zail Singh achieved the maximum tuber diameter of (38.64 mm) in October 15th transplanting while Anarkali had the smallest tuber diameter (17.59 mm) in December 15th transplanting.

When transplanting was done on October 15th, tuber reached its maximum length of (17.71 cm) and its lowest length (4.99 cm) in terms of December 15th transplanting. Matungini had the longest length of tubers (13.24 cm) and Giani Zail Singh had the shortest (11.43 cm). Interaction effects showed that Matungini produced the longest length of tubers (19.08 cm) in October 15th transplanting while Giani Zail Singh reported the shortest (4.84 cm) in December 15th transplanting.

The plant reached its highest tuber weight per plant of (519.13 g) when cuttings were planted on October 15th and its lowest weight of (54.50 g) in December 15th transplanting. Anarkali had the highest tuber weight (368.90 g) whereas Suryadev had the lowest (189.06 g). Anarkali reached the highest tuber weight of (728.15 g) in October 15th transplanting whereas Suryadev had the lowest weight of (33.10 g) during December 15th transplanting, showcasing interaction effects.

The highest tuber yield per plot (2829.83 g) was recorded when transplanting was performed on October 15th while the lowest yield (282.36 g) was seen in case of December 15th transplanting. Anarkali produced the highest tuber yield per plot (2004.06 g) while Suryadev produced the lowest (1084.50 g). Anarkali achieved the highest tuber yield per plot (3988.67 g) in October 15th transplanting while Suryadev had the lowest yield (124.32 g) in December 15th transplanting.

The plant had the maximum tuber production per plot of (2.83 kg) during October 15th transplanting and the lowest of (0.28 kg) in December 15th transplanting. Anarkali yielded (2.00 kg) of tubers per plot, the highest among all cultivars, while Suryadev yielded the lowest (1.04 kg). Anarkali achieved the highest tuber production per plot (3.99 kg) in October 15th transplanting whereas

Suryadev had the lowest yield (0.124 kg) in December 15th transplanting, as shown by interaction effects.

The results are consistent with prior research conducted by Sheergojri et al. [13] Sabah et al. [1] and Zhang et al. [14] on dahlia. Differences in tuber output among cultivars are due to their capacity to respond to environmental circumstances, which affects tuber development. Genetic variances, soil composition and certain environmental factors may influence changes in tuber weight. Ahmad and Khurshid [15] Gupta et al. [3] Kumar et al. [2] and Ahmad and Gul [16] have all found that varietal differences and genetic variants affect tuber weight in Dahlia cultivars.

4. CONCLUSION

Anarkali is a standout cultivar, demonstrating consistent and commendable performance across various parameters, including the weight of tubers per plant, tuber yield per plot in grams and kilograms. The cultivar Matungini performed the best in terms of the number of tubers and the length of tubers, while Giani Zail Singh was the best for the diameter of tubers. October 15th was found to be most suitable month of planting as interpreted from overall performance in terms of tuber production and characteristics.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

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AI Technology: OpenAI's GPT-3
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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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