

## Assessing the Performance and Flower Quality of *Dendrobium* Varieties Grown Under Shade-net in Konkan Region

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**ABSTRACT:** *Dendrobium* orchids are highly valued for their aesthetic appeal and durability, constituting a major segment of the global orchid market. A study was conducted in the Konkan region of Maharashtra (India) to determine the most suitable varieties for the specific climatic conditions of this area. The research was carried out under shade-net condition at the Hitech Nursery, College of Horticulture, Dapoli, in a Randomized Block Design (RBD) that included twelve varieties and thrice replications. The research revealed significant differences in various characteristics, including the timing of inflorescence emergence, spike length, the number of florets per spike, as well as flower length, diameter, and overall lifespan among different cultivars. During the findings, 'Areedang Blue' showed early inflorescence emergence as well as flowering (14.5 days), while 'Thongchai Gold x Udom Yellow' had late inflorescence emergence and flowering (19.89). The variety 'White 5N' was particularly noted for its extended spike length (57.60 cm) and consistently high florets per spike (10.66), while 'Sonia Red' was recognized for having the longest flower lifespan (62.59 days) with good flower size. Conversely, certain varieties such as 'King Dragon' and 'Burana Jade x Madam Vipa' did not expressed their potential to the local environment. This investigation offers prime information for the selection of best *Dendrobium* varieties suitable for cultivation in Konkan region under shade-net condition.

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**KEYWORDS:** *Dendrobium* orchids, Konkan region, inflorescence emergence, spike length, flower lifespan, cultivation, shade-net conditions.

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### INTRODUCTION

*Dendrobium* orchids are popular for their stunning beauty, strength and long-lasting lifespan, positioning them as a highly desirable product within the international floral market. Representing approximately 30% of the global orchid trade, *Dendrobium* species play a vital role in the floral industry, with increasing demand fueled by their popularity in both cut flower arrangements and potted plants. The increasing interest in orchids has led to a demand for new varieties that can grow well in different environments. However, the performance of various *Dendrobium* varieties in different climates, especially in Maharashtra's Konkan region, is not well researched. This region, known for its unique tropical monsoon climate, has great potential for growing *Dendrobium*. A two-year research study was carried in the Konkan area of Maharashtra under shade-net to test popular twelve varieties of *Dendrobium* orchids. The objective of this study was to evaluate the best-performing *Dendrobium* variety in terms of flower quality and quantity under shade-net conditions in the Konkan region.

Kumar *et al.* (2012) reported that the *Dendrobium aphyllum* flowers the earliest, in 136 days. The most flowers per spike (20.0) came from the *Dendrobium* germplasm D<sub>11</sub>, while, longest flower lifespan of 31.0 days, in the germplasm D<sub>1</sub>, (Moniruzzaman and Ara, 2012). *Dendrobium* cv. Sonia-17 variety had the longest spike length of 44.6 cm, the most flowers per spike (an average of 12.2) and the highest floret diameter of 9.5 cm when compared to the other two types (Mehraj *et al.*, 2014). The longest spike measured 32.70 cm in cv. 'White Eva' (21.3 cm) of *Dendrobium*. On the other hand, 'Victoria' and 'Airy Peach' had bigger flower diameters of 82.50 mm and 14.14 mm, respectively. The cultivar 'Dew White' had the most flowers, with an average of 8.0 florets

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per spike (Biswal *et al.*, 2017). Sudeep *et al.* (2018) observed that the first emergence and opening happened earliest in *Dendrobium* var. Big White with 30.42 days, followed closely by var. Mono Red with 31.41 days. Var. Sonia-17 took a bit longer with 32.26 days, while var. Burana Jade had the latest opening at 43.52 days. The longest spike was in variety Mono Red of 37.54 cm, followed by Big White of 36.12 cm and Bubble Gum of 34.14 cm. Burana Jade had the shortest spike of 20.72 cm. The *Dendrobium* variety 'Woon Leng' had the shortest spike length at 28.5 cm, while 'Massaco' was slightly longer at 30.9 cm. The variety 'Snow White' had the most florets per spike, averaging 8.4, with 'Juwita' next at 7.5. In contrast, 'Massaco' had the least florets per spike at 4.1, followed closely by 'Woon Leng' with 4.2 (Thirugnanavel *et al.*, 2019). Ramya *et al.* (2023) studied in *Phalaenopsis* Orchids and noticed that the 'Washington' variety had the earliest spike emergence at 307.64 days and the first floret opening at 360.98 days. This was followed by the Bilbao variety, which had spike emergence at 316.01 days and floret opening at 377.35 days. 'Washington' also had the highest number of flowers per spike, averaging 4.96, with the longest spike longevity of 62.99 days, while Volterra had the fewest flowers per spike, with 2.42 flowers per spike, with the longest floret length at 7.09 cm and the largest floret diameter at 7.55 cm.

### MATERIAL AND METHOD

A two-year research study (2021-22 and 2022-23) was carried out in the shade-net conditions of Konkan to evaluate popular twelve *Dendrobium* varieties in randomized block design (RBD) at Hi-tech Nursery, College of Horticulture, Dapoli, Ratnagiri. The varieties studied were namely; V<sub>1</sub> - Sonia Red, V<sub>2</sub> - Sonia White, V<sub>3</sub> - White 5N, V<sub>4</sub> - Panjarat Pink, V<sub>5</sub> - King Dragon, V<sub>6</sub> - Ladda Red, V<sub>7</sub> - Sirin Peach, V<sub>8</sub> - Areedang Blue, V<sub>9</sub> - Tuang Pink x Burana Stripe, V<sub>10</sub> - Tanida Pink Stripe x Hawaii Stripe, V<sub>11</sub> - Burana Jade x Madam Vipa and V<sub>12</sub> - Thongchai Gold x Udom Yellow. The planting material was procured from Rise n' Shine Nursery, Kunjirwadi, Pune, MS. The young seedlings of various varieties were immersed in a 0.1% solution of Bavistin prior to planting. The plants were grown in 8-inches aeriated plastic pots in coconut-husk potting media. Fertilizer doses of 19:19:19 (NPK) was applied monthly during the vegetative stage, and 00:00:50 (NPK) was used during the flowering stage, beginning 30 days after planting. Environmental factors like humidity, light, temperature was also monitored. The varieties were assessed by observing and recording their performance and quality features like period of inflorescence emergence and flowering, spike length, flower count, floret length and diameter, spike longevity. The data recorded during the work was combined and analyzed using standard statistical methods.

### RESULTS AND DISCUSSION

#### 1. Period of inflorescence emergence to full flowering

The results presented in Table 1 and depicted in Fig. 1 highlights significant differences in the time from inflorescence emergence to flowering among various *Dendrobium* cultivars over two years. In the first year of the study, the shortest time for this process was recorded in variety V<sub>8</sub> - Areedang Blue with 15.03 days. This was statistically at par with varieties V<sub>7</sub>-Sirin Peach (15.20 days), V<sub>6</sub>- Ladda Red (15.97 days) and V<sub>9</sub>- Tuang Pink x Burana Stripe (17.43 days). The longest duration was observed in variety V<sub>12</sub> - Thongchai Gold x Udom Yellow of 20.97 days. In the second year, a similar pattern was seen, with inflorescence emergence to full flowering occurring two days earlier in variety V<sub>8</sub> - Areedang Blue (13.07 days). This was comparable to variety V<sub>7</sub> - Sirin Peach (13.08 days) and V<sub>6</sub> - Ladda Red (14.33 days), while variety V<sub>12</sub> - Thongchai Gold x Udom Yellow, had the longest duration at 18.80 days. When looking at the combined results from both years, the shortest time from inflorescence emergence to full flowering was in V<sub>8</sub> - Areedang Blue (14.05 days), which was on par with V<sub>7</sub> - Sirin Peach (14.14 days). The longest duration recorded was 19.58 days in variety V<sub>12</sub>-Thongchai Gold x Udom Yellow.

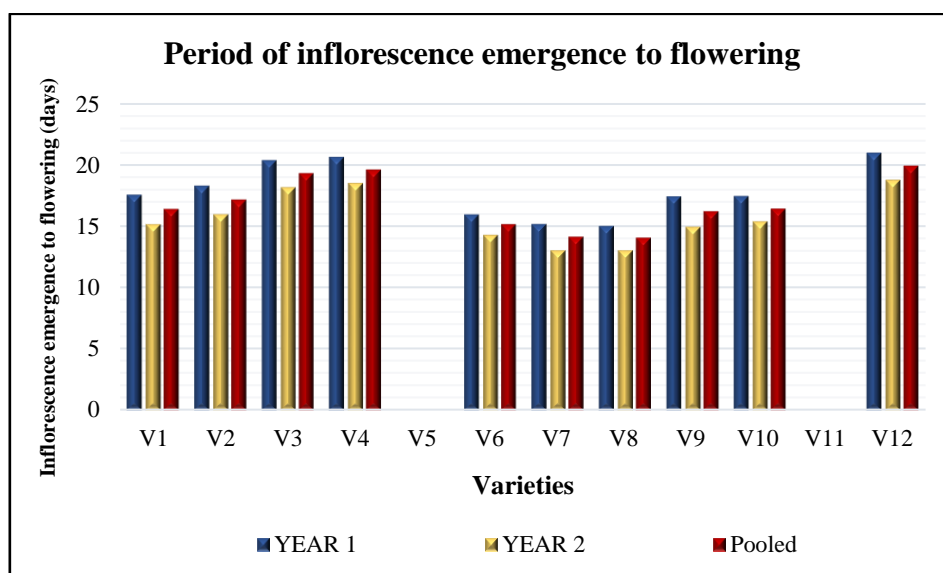
The study shows that genetic predispositions and environmental factors combine to change the length of inflorescence emergence and blooming, highlighting the complexity of factors controlling inflorescence development in *Dendrobium* orchids. The current results match what other researchers have found. Kumar *et al.* (2012) noted that *Dendrobium aphyllum* flowers the earliest. Sudeep *et al.* (2018) stated that the Big White cultivar also has early flowering among various *Dendrobium* varieties. Additionally, Ramya *et al.* (2023) observed that in *Phalaenopsis*, the 'Washington' variety shows the earliest spike emergence and flowering.

**Table 1. Period of inflorescence emergence to flowering in different varieties of *Dendrobium***

Tr. No.	Varieties	Period of inflorescence emergence to flowering		
		YEAR 1 (2021-22)	YEAR 2 (2022-23)	Pooled
V <sub>1</sub>	Sonia Red	17.57	15.20	16.39
V <sub>2</sub>	Sonia White	18.30	16.00	17.15

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V <sub>3</sub>	White 5N	20.37	18.20	19.29
V <sub>4</sub>	Panjarat Pink	20.63	18.53	19.58
V <sub>5</sub>	King Dragon	-	-	-
V <sub>6</sub>	Ladda Red	15.97	14.33	15.15
V <sub>7</sub>	Sirin Peach	15.20	13.08	14.14
V <sub>8</sub>	Areedang Blue	15.03	13.07	14.05
V <sub>9</sub>	Tuang Pink x Burana Stripe	17.43	14.97	16.20
V <sub>10</sub>	Tanida Pink Stripe x Hawaii Stripe	17.46	15.43	16.43
V <sub>11</sub>	Burana Jade x Madam Vipa	-	-	-
V <sub>12</sub>	Thongchai Gold x Udom Yellow	20.97	18.80	19.89
	<b>Mean</b>	<b>17.89</b>	<b>15.76</b>	<b>16.82</b>
	<b>F-Test</b>	<b>Sig.</b>	<b>Sig.</b>	<b>Sig.</b>
	<b>S.Em ±</b>	<b>0.35</b>	<b>0.24</b>	<b>0.31</b>
	<b>CD (p = 0.05)</b>	<b>1.03</b>	<b>0.70</b>	<b>0.96</b>



**Fig. 1. Period of inflorescence emergence to flowering in different varieties of *Dendrobium***

**2. Spike length (cm)**

The results on spike length are shown in Table 2 and Fig. 2. There were significant differences among all the varieties studied each year and in the overall data analysis. In the first year, a clear difference in spike length was observed across all varieties. The longest flower spike was found in variety V<sub>3</sub> - White 5N measuring 57.20 cm, while the shortest in V<sub>6</sub> - Ladda Red, at 24.80 cm. In the second year, a similar pattern emerged, with the longest spike again in variety V<sub>3</sub> - White 5N with 58.00 cm and the shortest in V<sub>6</sub> - Ladda Red with 25.53 cm. Further, the combined data from both years, resulted that the longest spike confirmed in variety V<sub>3</sub> - White 5N, measuring 57.60 cm, which was significantly superior over all other varieties studied and the shortest in V<sub>6</sub> - Ladda Red with 25.16 cm.

Genetic traits have a greater impact on spike length than external environmental factors. This suggests that while environmental influences do play a role in the differences observed, genetic factors are the primary influence on spike length. These findings align with earlier, of Mehraj *et al.* (2014), who found longest spike length (44.6 cm) in *Dendrobium* cv. Soina-17, while Biswal *et al.* (2017) reported the longest spike length in cv. White Eva. Additionally, Sudeep *et al.* (2018) noted the maximum spike length in ‘Mono Red’ while Thirugnanavel *et al.* (2019) observed it in the ‘Massacoin’ *Dendrobium* cultivar.

Table 2. Flower spike length (cm) in different varieties of *Dendrobium*

Tr. No.	Varieties	Flower spike length (cm)		
		YEAR 1 (2021-22)	YEAR 2 (2022-23)	Pooled
V <sub>1</sub>	Sonia Red	42.13	43.06	42.59
V <sub>2</sub>	Sonia White	41.73	42.86	42.29
V <sub>3</sub>	White 5N	57.20	58.00	57.60
V <sub>4</sub>	Panjarat Pink	40.80	41.93	41.36
V <sub>5</sub>	King Dragon	-	-	-
V <sub>6</sub>	Ladda Red	24.80	25.53	25.16
V <sub>7</sub>	Sirin Peach	42.60	43.66	43.13
V <sub>8</sub>	Areedang Blue	33.40	34.73	34.06
V <sub>9</sub>	Tuang Pink x Burana Stripe	30.26	31.20	30.73
V <sub>10</sub>	Tanida Pink Stripe x Hawaii Stripe	38.60	40.13	39.36
V <sub>11</sub>	Burana Jade x Madam Vipa	-	-	-
V <sub>12</sub>	Thongchai Gold x Udom Yellow	43.53	44.46	43.99
	<b>Mean</b>	<b>39.50</b>	<b>40.55</b>	<b>40.02</b>
	<b>F-Test</b>	<b>Sig.</b>	<b>Sig.</b>	<b>Sig.</b>
	<b>S.E.m ±</b>	<b>0.66</b>	<b>0.78</b>	<b>0.70</b>
	<b>CD (p = 0.05)</b>	<b>1.97</b>	<b>2.33</b>	<b>2.15</b>

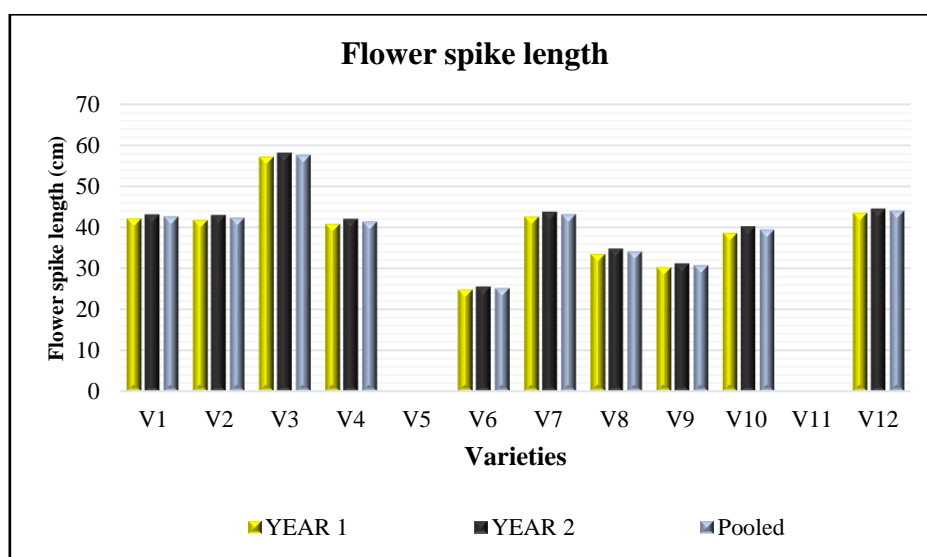


Fig. 2. Flower spike length (cm) in different varieties of *Dendrobium*

### 3. Number of florets per spikes

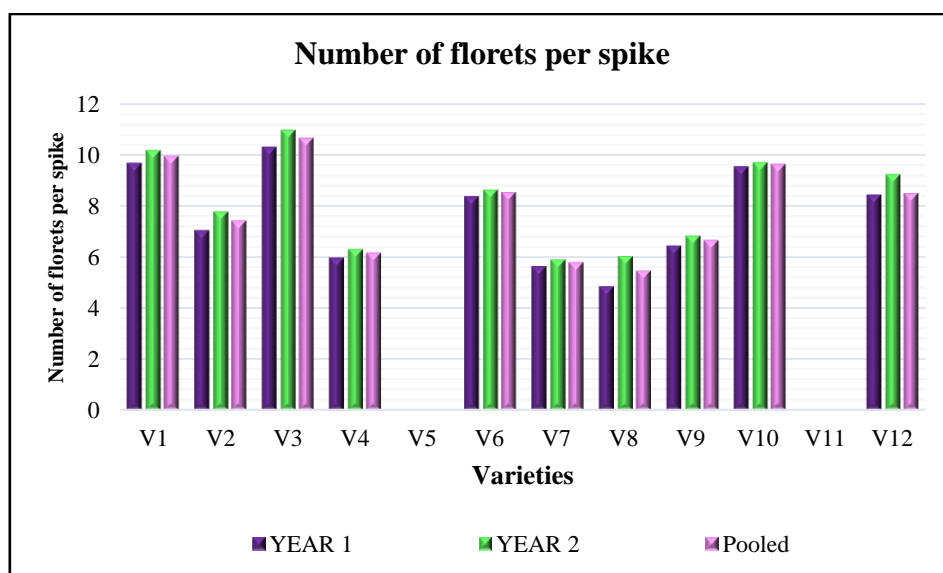
The data on the number of florets per spike in various *Dendrobium* varieties is presented in Table 3 and illustrated in Fig. 3. Notable differences were found among all the cultivars studied, which are explained further below. In the first year of the trial, the highest average of 10.33 florets per spike were noted in variety V<sub>3</sub> - White 5N. It was similar to the counts for variety V<sub>1</sub> - Sonia Red (9.70) and variety V<sub>10</sub> - Tanida Pink Stripe x Hawaii Stripe (9.56), while variety V<sub>8</sub> - Areedang Blue had the lowest with 4.86 florets. In the second year, variety V<sub>3</sub> again led with 11.00 florets, being on par with V<sub>1</sub> with 10.20 florets per spike, while variety V<sub>7</sub> - Sirin Peach had the fewest with 5.93 florets. Overall, the combined data from both years revealed that variety V<sub>3</sub> - White 5N, consistently had the highest average of 10.66 florets per spike, outperforming among all other varieties. Varieties V<sub>1</sub> - Sonia Red (9.95) and V<sub>10</sub> - Tanida Pink Stripe x Hawaii Stripe (9.64), were also comparable to V<sub>3</sub>. In contrast, variety V<sub>8</sub> - Areedang Blue, had the lowest average of 5.46 florets per spike, making it the least favorable among the studied cultivars.

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The variation in the number of florets may be related to the genetic potential of each type, highlighting the importance of genetic factors in determining the flowering traits of *Dendrobium* orchids. Sudeep *et al.* (2018) found that the *Dendrobium* variety Bubble Gum had the most flowers per spike. In contrast, Thirugnanavel *et al.* (2019) noted that the Snow White cultivar of *Dendrobium* had the highest number of florets. Additionally, Ramya *et al.* (2023) reported that the *Phalaenopsis* variety Washington had the most florets per spike.

**Table 3. Number of florets per spike in different varieties of *Dendrobium***

Tr. No.	Varieties	Number of florets per spike		
		YEAR 1 (2021-22)	YEAR 2 (2022-23)	Pooled
V <sub>1</sub>	Sonia Red	9.70	10.20	9.95
V <sub>2</sub>	Sonia White	7.06	7.80	7.43
V <sub>3</sub>	White 5N	10.33	11.00	10.66
V <sub>4</sub>	Panjarat Pink	6.00	6.33	6.17
V <sub>5</sub>	King Dragon	-	-	-
V <sub>6</sub>	Ladda Red	8.40	8.66	8.53
V <sub>7</sub>	Sirin Peach	5.66	5.93	5.79
V <sub>8</sub>	Areedang Blue	4.86	6.06	5.46
V <sub>9</sub>	Tuang Pink x Burana Stripe	6.46	6.86	6.66
V <sub>10</sub>	Tanida Pink Stripe x Hawaii Stripe	9.56	9.73	9.64
V <sub>11</sub>	Burana Jade x Madam Vipa	-	-	-
V <sub>12</sub>	Thongchai Gold x Udom Yellow	8.46	9.26	8.50
	<b>Mean</b>	<b>7.64</b>	<b>8.18</b>	<b>7.87</b>
	<b>F-Test</b>	<b>Sig.</b>	<b>Sig.</b>	<b>Sig.</b>
	<b>S.E.m ±</b>	<b>0.28</b>	<b>0.26</b>	<b>0.25</b>
	<b>CD (p = 0.05)</b>	<b>0.83</b>	<b>0.82</b>	<b>0.77</b>



**Fig. 3. Number of florets per spike in different varieties of *Dendrobium***

**4. Flower length and diameter (cm)**

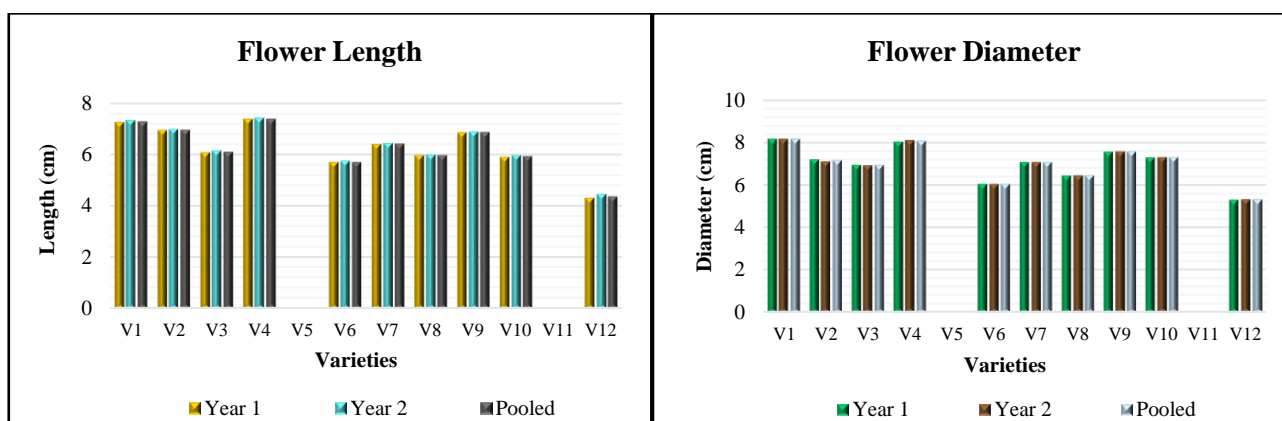
The results of the two-year study on floret length and diameter are putforth in Table 4 and Fig. 4. During both years, variety V<sub>4</sub> - Panjarat Pink gave the longest florets (7.39 cm and 7.44 cm, respectively), which was at par with variety V<sub>1</sub> - Sonia Red (7.27 cm and 7.36 cm). The pooled data indicated that the greatest floret length was measured in V<sub>4</sub> with 7.41 cm, which was

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at par with V<sub>1</sub> with 7.31 cm. During both years, and pooled data revealed that variety V<sub>12</sub> - Thongchai Gold x Udom Yellow had the shortest floret length among all varieties, measuring 4.39 cm. Similarly, the varieties differed in terms of floret diameter. In the both years, the variety V<sub>1</sub> - Sonia Red had the biggest diameter of 8.15 cm and 8.14 cm, respectively. The pooled data of the years revealed that V<sub>1</sub> - Sonia Red showed the maximum flower diameter, measuring 8.14 cm, which was superior over all other varieties. In contrast, variety V<sub>12</sub> - Thongchai Gold x Udom Yellow had the lowest diameter throughout both years, measuring 5.29 cm and 5.31 cm, respectively, with pooled data measuring 5.30 cm. Research over two years showed that the size of florets in various *Dendrobium* varieties are mainly affected by genetic factors, with environmental influences also being significant. These findings align with Mehraj *et al.* (2014), who noted the largest flower diameter of 9.5 cm in Sonia-17 and Sudeep *et al.* (2018), who found a maximum floret diameter of 7.04 cm in *Dendrobium* varieties grown in polyhouse conditions. Similar results were also reported by Ramya *et al.* (2023) in *Phalaenopsis*.

**Table 4. Length and diameter of florets (cm) in different varieties of *Dendrobium***

Tr. No.	Varieties	YEAR 1 (2021-22)		YEAR 2 (2022-23)		Pooled	
		Length (cm)	Diameter (cm)	Length (cm)	Diameter (cm)	Length (cm)	Diameter (cm)
V <sub>1</sub>	Sonia Red	7.27	8.15	7.36	8.14	7.31	8.14
V <sub>2</sub>	Sonia White	6.96	7.18	7.00	7.08	6.98	7.13
V <sub>3</sub>	White 5N	6.09	6.92	6.17	6.90	6.13	6.91
V <sub>4</sub>	Panjarat Pink	7.39	8.01	7.44	8.08	7.41	8.04
V <sub>5</sub>	King Dragon	-	-	-	-	-	-
V <sub>6</sub>	Ladda Red	5.71	6.03	5.76	6.02	5.73	6.02
V <sub>7</sub>	Sirin Peach	6.42	7.06	6.46	7.05	6.44	7.05
V <sub>8</sub>	Areedang Blue	5.98	6.42	6.00	6.43	5.99	6.42
V <sub>9</sub>	Tuang Pink x Burana Stripe	6.87	7.54	6.91	7.55	6.89	7.54
V <sub>10</sub>	Tanida Pink Stripe x Hawaii Stripe	5.92	7.27	5.98	7.28	5.95	7.27
V <sub>11</sub>	Burana Jade x Madam Vipa	-	-	-	-	-	-
V <sub>12</sub>	Thongchai Gold x Udom Yellow	4.32	5.29	4.46	5.31	4.39	5.30
	<b>Mean</b>	<b>6.29</b>	<b>6.98</b>	<b>6.35</b>	<b>6.98</b>	<b>6.32</b>	<b>6.98</b>
	<b>F-Test</b>	<b>Sig.</b>	<b>Sig.</b>	<b>Sig.</b>	<b>Sig.</b>	<b>Sig.</b>	<b>Sig.</b>
	<b>S.Em ±</b>	<b>0.042</b>	<b>0.030</b>	<b>0.032</b>	<b>0.016</b>	<b>0.024</b>	<b>0.025</b>
	<b>CD (p = 0.05)</b>	<b>0.13</b>	<b>0.08</b>	<b>0.10</b>	<b>0.05</b>	<b>0.075</b>	<b>0.077</b>



**Fig. 4. Length and diameter of florets (cm) in different varieties of *Dendrobium***

**5. Flower longevity on plants (days)**

The findings from the two-years study on flower lifespan of *Dendrobium* orchid are shown in Table 5 and depicted in Fig. 5. There were significant differences noticed among the various flower varieties in both years. In first year, the variety V<sub>1</sub> -



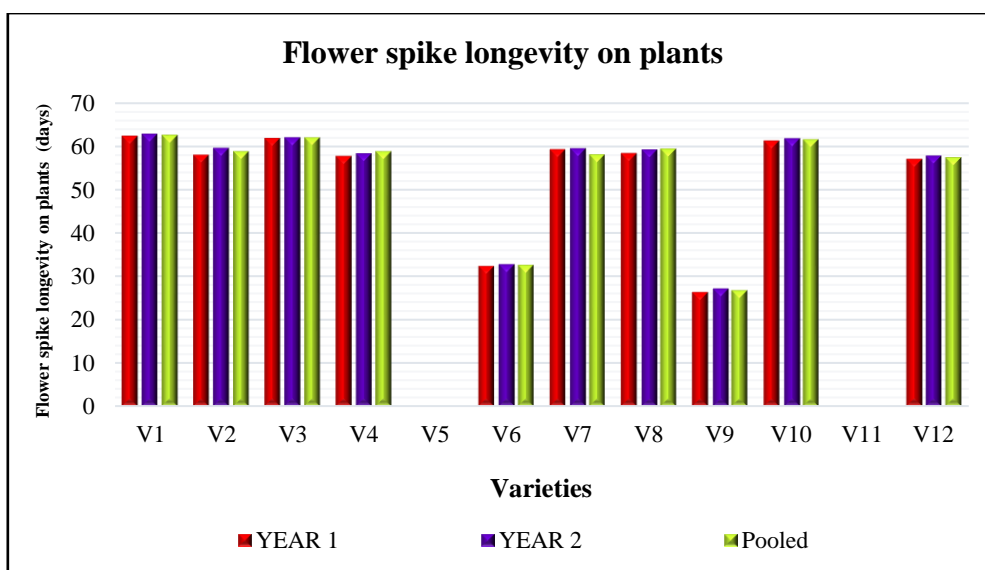
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Sonia Red had the longest flower life, averaging 62.26 days. This was at par with V<sub>3</sub> - White 5N and V<sub>10</sub> - Tanida Pink Stripe x Hawaii Stripe, which had average lifespans of 61.80 and 61.20 days, respectively. In contrast, V<sub>9</sub> - Tuang Pink x Burana Stripe had the shortest lifespan of 26.33 days. In the second year, Sonia Red again showed the longest lifespan of 62.93 days, on par with V<sub>3</sub> (62.13 days) and V<sub>10</sub> (61.93 days). V<sub>9</sub> had the shortest lifespan with 27.26 days. In the pooled data from both years, Sonia Red gave the highest average lifespan of 62.59 days, at par with V<sub>3</sub> (61.96 days) and V<sub>10</sub> (61.56 days), all of which were statistically significant. V<sub>9</sub> had the lowest average at 26.79 days.

The variation in the longevity of flower spikes may be influenced by factors like temperature and humidity, along with the unique genetic traits of each variety. This highlights the complex connection between environmental influences and genetic makeup in affecting flower lifespan in *Dendrobium* orchid varieties. Research of Moniruzzaman and Ara (2012) indicated that the longest flower lifespan recorded was 31.0 days, observed in the D<sub>1</sub> germplasm of *Dendrobium*. The findings of this study align with earlier reports by Kumar *et al.* (2012) on *Cymbidium* and Ramya *et al.* (2023) reported that *Phalaenopsis* cv. Washington had the longest flower longevity.

**Table 5. Flower spike longevity on plants (days) in different varieties of *Dendrobium***

Tr. No.	Varieties	Flower spike longevity (days)		
		YEAR 1 (2021-22)	YEAR 2 (2022-23)	Pooled
V <sub>1</sub>	Sonia Red	62.26	62.93	62.59
V <sub>2</sub>	Sonia White	57.93	59.73	58.83
V <sub>3</sub>	White 5N	61.80	62.13	61.96
V <sub>4</sub>	Panjarat Pink	57.66	58.46	58.79
V <sub>5</sub>	King Dragon	-	-	-
V <sub>6</sub>	Ladda Red	32.33	32.93	32.63
V <sub>7</sub>	Sirin Peach	59.20	59.66	58.06
V <sub>8</sub>	Areedang Blue	58.26	59.33	59.43
V <sub>9</sub>	Tuang Pink x Burana Stripe	26.33	27.26	26.79
V <sub>10</sub>	Tanida Pink Stripe x Hawaii Stripe	61.20	61.93	61.56
V <sub>11</sub>	Burana Jade x Madam Vipa	-	-	-
V <sub>12</sub>	Thongchai Gold x Udom Yellow	56.93	57.93	57.43
	<b>Mean</b>	<b>53.39</b>	<b>54.22</b>	<b>53.80</b>
	<b>F-Test</b>	<b>Sig.</b>	<b>Sig.</b>	<b>Sig.</b>
	<b>S.Em ±</b>	<b>0.44</b>	<b>0.41</b>	<b>0.42</b>
	<b>CD (p = 0.05)</b>	<b>1.29</b>	<b>1.22</b>	<b>1.26</b>



**Fig. 5. Flower spike longevity on plants (days) in different varieties of *Dendrobium***

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The cultivars King Dragon and Burana Jade x Madam Vipa did not produce any flowers during the two years of the study, primarily because they were unable to thrive in the Konkan region environment. Consequently, no observations regarding flowering parameters for these two varieties were documented.

### CONCLUSION

*Dendrobium* varieties Areedang Blue consistently showed lowest duration, while Thongchai Gold x Udom Yellow had the greatest duration in both year research on inflorescence emergence to complete blooming period. The length of the spikes, number of florets per spike, length, diameter, and longevity of the flowers differed across the varieties as well; varieties Sonia Red and White 5N showed superiority in several aspects among all the varieties. These findings indicate considerable variances across the cultivars tested, giving useful information for future study and production strategies.

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