Cerato-Phalae系デンドロビウムの発育に及ぼす温度の影響(生物生産学科)

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Influence of Temperature on the Growth of Cerato-Phalae Type Dendrobium

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Summary

The relationship between the growth of Cerato-Phalae type Dendrobium and some variation of temperature was investigated with two experiments by using 4 facilities of artificial climate. Consequently the following matters were clarified. 1. Although this group of Dendrobium are usually classified as one of the orchids which prefers high temperature, it was clarified that 35 ℃ day and 30 ℃ night temperatures are too high not only for the vegetative growth but also for the reproductive growth. 2. The 20 ℃ day and 15 ℃ night temperature is too low for the growth of this group of Dendrobium. 3. The 30-25 ℃ day and 25-20 ℃ night temperatures are suitable for this Dendrobium at both the vegetative and reproductive stages. 4. This group of Dendrobium basically does not have dormancy in its growth cycle. The seasonality of flowering which is observed strongly in subtropical and temperate regions might be brought by the low temperature in the winter season.

Introduction

Dendrobium, which is the largest genus in the orchid family, has been classified by taxonomists into 41 sections since early in this century(6). Among these sections, the Ceratobium and Phalaenanthe sections have suitable natures for obtainimg cut flowers. Both sections can be used for getting new hybrids by crossing, because they have fertility with each other's sections (3,8). These hybridized groups of Dendrobium have been recognized as the most important plants with cut flowers in the tropical regions. However, researches related to growth and environmental factors have not been sufficiently reported, even at the tropical countries. Experiments were carried out in four separate rooms to clarify the relationship between the growth and temperature factors by using Koitotoron which is able to control environmental factors artificially.

Materials and Methods

As materials of first experiment, Dendrobium Pramot (D. Toshiko x D. Lois

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Anderson) that had been grown to mature size were used. Uniformity of the materials was controlled by following the standard of using only those plants with a new sprout about 4 cm long at the base of the mature pseudobulb. Each plot contained 11 or 12 plants. For experimental plots with merging temperatures were prepared as follows; plot 1 , 35 ℃ in day time 30 ℃ in night time; plot 2 , similarly 30–25 ℃; plot 3 , 25–20 ℃ and plot 4 , 20–15 ℃. Day time temperature was determined at 13 hours from 07:00 to 20:00. The experiment was continued from April to October, 1984. All plants were fertilized equally by using the modified liquid nutrition OK F-1 , made by Ohthuka Chem. Co. It contained the following nutrients; nitrogen 15.0% (nitrate 8.5), phosphate 8.0%, potasium 17.0%, magnesium 2.0%, manganese 0.1%, boron 0.1%, and chilate iron 0.1% respectively. Before fertilizing, the percentage of phosphate was modified to 15.0% by adding superphosphate of lime. All plants were fertilized once a week at 100 ppm concentration of nitrogen level. Watering was carried out every one or two days depending on the degree of dryness of the pumice stones that were used as the planting substance. The condition of 70% relative humidity was maintained.

A second experiment was carried out to clarify the relationship between the sprouting of new shoots and combined temperature on day and night time in the controlled rooms. Uniform plants of D. Pramot at the dormant stage which had flowered the previous fall, and which had normal buds at the base of old plants, were arranged as experimental materials. 60 plants totally were used as materials in this case. Experimental plots of temperature in this investigation were set at 30–25, 30–18, 30–10, 23–18, and 15–10 ℃. Day time and night time were 12 hours respectively as above. Observation was continued for 5 weeks beginning at the end of January, 1985.

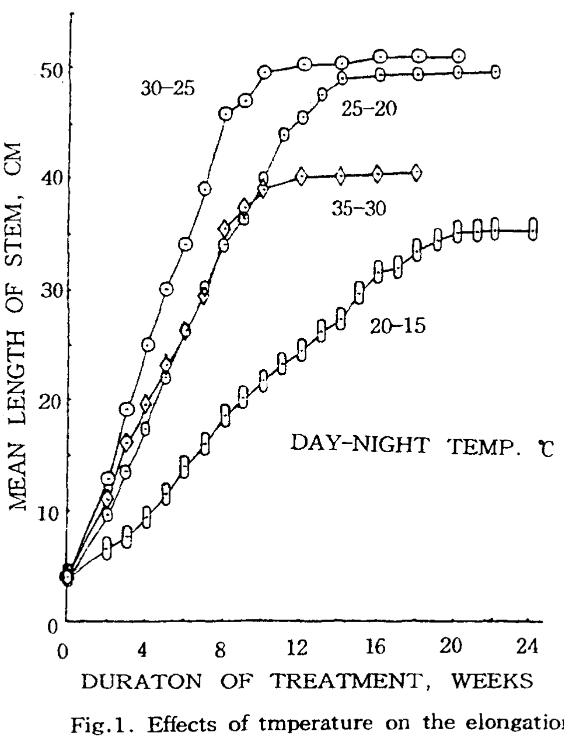

Fig.1. Effects of tmperature on the elongation of stem of shoots with Dendrobium Pramot.

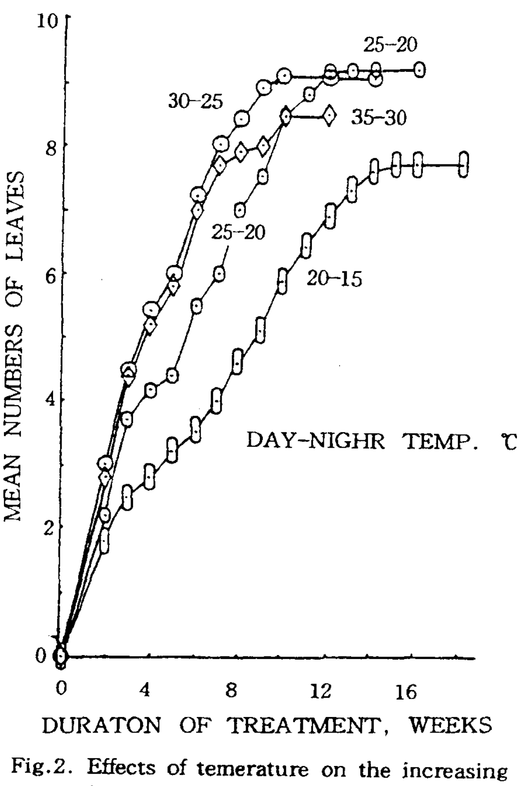

Fig.2. Effects of temerature on the increasing of leaves of shoots with Dengrobium Pramot.

Results and Discussion

The results of increasing stem length along the time line in the controlled rooms with new shoots of D. Pramot are summarized in Fig. 1. All plants except those in the 20–10 ℃ plot increased in stem length rapidly after being transfered to their respective rooms. The plants in the 20–15 ℃ room showed a tendency of a relatively gentle slope. The time durations for the arrival at maximum stem length were different depending on each plant in the group in the controlled rooms. The elapsed times were about 10 weeks in the 35–30℃ and the 30–25℃ plots, 14 weeks in the 25–20℃ plot and 20 weeks in the 20–15℃ plots respectively. At the 35–30 ℃ plot, the increasing of stem length stopped about 20% short of that in the 25–20 ℃ plot, however, it showed rapid growth. Shoots in the 20–15 ℃ plot barely reached only 70% of the level of stem length at in the 30–25 ℃ plot.

The results of increasing of the number of leaves along the time line of the same plants formerly mentioned were summarized in Fig.2. The general tendency for the increasing of leaves was shown briefly to be the same as in the case of stem length. The plants rapidly reached the maximum number of leaves with large values in the 30–25 ℃, 25–20 ℃ plots; the plants reached the maximum number in a short duration of time but with a fewer number of leaves in the 35–30 ℃ plot; but the plants required a long time for the maximum number of leaves in the lower figures. In relation to the counting of leaves, some explanation might be necessary about the peculiar form of leaf in Dendrobium. With some Dendrobium included in the Cerato–Phalae type, plants have a kind of scaly leaf lower on the stem beneath the complete leaves. In these plants, a leaf sheath which envelopes the stem is complete but the blade is imcomplete and it differs very much in size and shape and usually defoliates at the part of the abscission layer soon after complete leaves have developed. Those kinds of leaves are excluded in this investigation.

Table 1. Effects of temperature on the rooting of new shoots with early stage of Dendrobium Pramot.

Treatment Day−Night Temp. ℃	Number of Plants Examined	Days until First Rooting	Number of Roots at 5 weeks	Root Length at 5 weeks cm
35−30	11	14.8a	20.1a	5.5a
30−25	12	16.7a	13.5a	4.3ab
25−20	11	24.8a	13.0a	2.4b
20−15	12	93.8b	0.6b	0.1c

N. B. Each mean was separated by Duncan's multiple range test at 5% level. Marks in the other tables are the same.

The aspects of rooting in the early stage of new shoot growth were summarized in Table 1. As seen in Table 1, the number of days needed for first rooting became shorter as the temperature rose, only 15 days in 35–30 ℃ plot from the initial time when the new shoots had about 4 cm length. On the other hand, the plants in the 20–15 ℃ plot needed 90 days until first rooting. A general tendency was shown that the number of days required for rooting increased as the temperature decresed.

Table 2. Effects of temperature on the vegetative growth of new shoots of Dendrobium Pramot.

Treatment Day–Night Temp. ℃	Number of Plants Examined	Stem Length cm	Number of Leaves	Size of Max. Leaves Length x Width cm	Number of Roots
35–30	11	40.7b	8.6ab	15.1 x 5.5a	34.3a
30–25	12	51.1a	9.2a	15.3 x 6.1a	25.5b
25–20	11	49.8a	9.2b	13.8 x 5.3a	28.0ab
20–15	12	35.5c	7.3	10.8 x 3.8b	9.5c

Details about the other characteristics of vegetative growth were summarized in Table 2. Plants grown in the 35–30 ℃ room showed less length of stem, and fewer number of leaves, even though there was a large number of roots and they rooted early. On the other hand, plants grown in the 20–15 ℃ plot showed an insufficient total level of growth. It reached only 70% of the stem length and less than 90% of the number of leaves in the 30–25 ℃ plot. As for the vegetative growth of D. Pramot, suitable temperatures were concluded to be 30–25 ℃ and 25–20 ℃, because both groups of plants showed sufficient values in some characteristics as seen in Table 2.

Table 3. Effects of temperature on the flowering of new shoots of Dendrobium Pramot.

Treatment Day–Night Temp. ℃	Number of plants Examined	Days until First Flowering	Length of Inflores. cm	Length of F. Stem cm	Number of Flowers per Scape	Size of Flowers cm	Ratio of Bud Drop %
35–30	11	113.4a	47.7a	19.1ab	15.7a	5.0c	1.91
30–25	12	109.1a	46.7a	23.7a	13.5a	6.8b	0.01
25–20	11	134.0b	46.3a	16.8b	16.0a	7.6a	0.01
20–15	12	182.6c	30.6b	8.0c	12.1a	6.7b	0

Some characteristic values related to flowering of D. Pramot were summarized in Table 3. As seen in Table 3, the number of days required for first flowering in each plot were shown as about 16 weeks in the 30–25 and 35–30 ℃ plots, 15 weeks in the 25–20 ℃ plot and 26 weeks in the 20–15 ℃ plot respectively, considerably different durations. The length of inflorescence which is measured from the base of the flower stem to the joint part of the final flower and the length of flower stem which is measured from the same basal part to the point of first flower were shown to be extremely short in the 20–15℃ plot. The largest length of these two characteristics were obtained in 30–25℃ plot. With the size of flower, which is measured as the distance between the outer parts of two petals, flowers in the 35–30℃ plot were shown to be extremely short compared with the other lower temperature plots. Moreover at higher temperatures, it was observed that there was a much lighter color from the reddish parts of petal tips. The shape and flower color in this plot were simlar to the flower of D. Jaquelyn Thomas which preceded it by two generations. The largest flowers were obtained in the 25–20 ℃ plot and there was also a tendency for the flower color to grow darker as the temperature declined. For the reproductive growth of D. pramot, 30–25℃ of day temperature and 25–20 ℃ night temperature were observed to be the optimum range.

The sprouting of new shoots at the base and the upper parts of mature pseudobulb after flowering under the same culture conditions are summarized in Table 4. Though there was no sign at all of new sprouting in the 20–15 ℃ plot, there was more than 80% sprouting in the plots of higher temperature as the temperature rose. Because of earlier sprouting, the new shoots in the 35–30℃ plot showed longer stems and many more leaves as seen in Table 4. The tendency of new sprouting was also observed in the plants where flower buds aborted. Aerial shoots which originated from the upper part of mature pseudobulb were produced only in the 35–30 ℃ plot.

Table 4. Effects of temperature on the sprouting of new shoots from base and upper part of mature pseudobulbs of Dendrobium Pramot.

		Sprouted at Base			Sprouted at Upper Part		
Treatment Day−Night Temp. ℃	Number of Plants Examined	Ratio of Shoots Sprouted %	Length of Shoots cm	Number of Leaves	Ratio of Shoots Sprouted %	Length of Shoots cm	Number of Leaves
35−30	11	81.8	20.7a	7.6a	36.4	12.6	4.8
30−25	12	100	12.8ab	4.8b	0	0	0
25−20	11	81.8	7.0b	4.0b	0	0	0
20−15	12	0	0	0	0	0	0

N. B. Measured at 30 weeks cultivation in the controlled rooms.

To summarize the aspects of growth, including vegetative and reproductive stages, in regard to the temperature factor, the following results may be clarified. The 35–30 ℃ temperature had an undesirable influence on some characteristics, such as the smaller flower size, shortening n scape length, and a lighter hue in flower color, especially at the reproductive stage. There were also undesirable effects at vegetative growth stage such as stem length and number of leaves, though rooting was satisfactory. These results might suggest that the unbalance of nutritional accumulation caused by photosynthesis and high respiration consequently disturbed the development of the flower buds in their most sensitive stage. This is understandable from the fact that aerial shoots were produced only in the 35–30 ℃ temperature plot. Although 20–15 ℃ is too low for the growth of D. Pramot at both the vegetative and the reproductive stages, 30–25℃ day and 25–20℃ night temperature are suitable for growth of both stages. On the other hand, it is obvious that the new sprouting was produced soon after flowering if the same condition of relatively high temperature continued. It might be certified that this group of Dendrobium basically does not have the dormancy nature. Regarding the flowering factors of this plant, it was obvious that flower buds came out at about the same time on final leaf expanding regardless of the different combination of temperatures. It mitht be considered that the maturity of pseudobulbs is the dominant factor for the initiation of flower buds on the new pseudobulbs. The photoperiod or thermofactors have less influence in this case, although there have been reports concerning this with other orchids (2,5). Meanwhile, the nutritive condition fertilized in this research, might be adequate for the vegetative and reproductive growth of Dendroium. Although only pumice stones were used as planting material, there were no conspicuous problems. This is indicates that this group of Dendrobium might be responsive to a wide range of nutritive conditions as was indicated in some reports (1,4,7).

Table 5. Effects of temperature on the sprouting of dormant buds of Dendrobium Pramot.

Treatment Day−Night Temp. ℃	Number of Plants Examined	Ratio of Plants Sprouted %	Days until Sprouting	Length of Shoots at 5 weeks cm
30−25	12	100	17.6a	5.9a
30−18	12	100	24.8b	2.5b
30−10	12	91.7	32.0c	0.6c
23−18	12	66.7	32.5c	0.5c
15−10	12	0	0	0

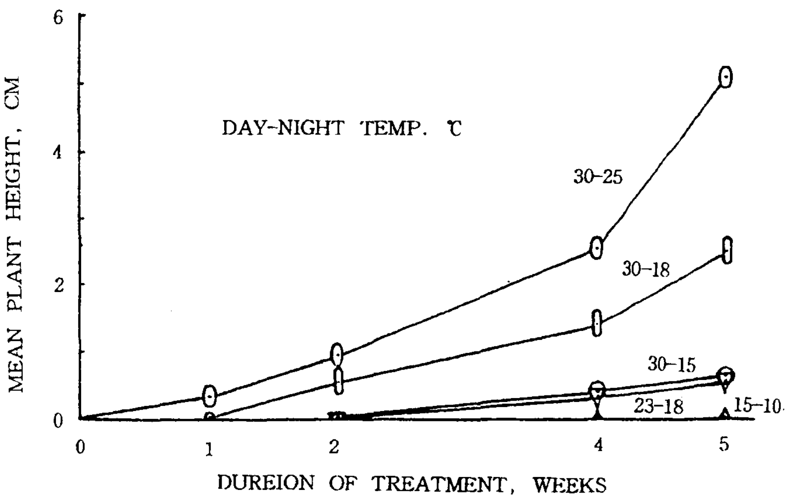

Fig. 3. Effects of temperature on the sprouting of new shoots with Dendrobium Pramot.

The influences of temperature on the sprouting of new shoots with D. Pramot are summarized in Table 5. The percentages of new sprouting were 100% in the 30-25 ℃ and 30-18 ℃ plots and 0% in 15-10 ℃ plot. Generally, there were fewer sprouts as the combined day and night temperature decreased. With the comparison of the number of days needed for sprouting, there was an obvious tendency that high temperatures were most effective and effectiveness decreased gradually as temperature became lower.

There was a 3 weeks difference with a 15 ℃ variation of night temperature even though the day temperature remained the same. As a result, the plant height in the high temperature plot was longer because of early initiation of stem elongation.

The results of increasing stem length along the time line are summarized in Fig. 3. As a matter of course, the growth curve rises rapidly in the high temperature room because of the early onset of sprouting. There was an interesting result that approximately the same start of sprouting was observed in both the 30–10 ℃ and 23–18 ℃ plots in which the total temperature of day and night time were the same. Regarding the problem of dormant nature which usually exists in winter season in subtropical regions, it is obvious that this nature can easily be broken by high temperature treatment such as 30–25 ℃.

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Cerato-Phalae系デンドロビウムの発育に及ぼす温度の影響

上里健次*

摘　　要

切り花用として栽培されるCerato-Phalae系デンドロビウムの、発育に及ぼす温度の組み合わせの影響を、人口気象室を使用して比較検討した。供試材料はD.Pramotの開花３年生株で、日中温度20，25，30，35℃に５度差の夜温を組み合わせた中で開花まで追跡調査したものと、冬季における萌芽への温度の影響を検討した２つのグループの実験を実施した。得られた結果の概要は次のとうりである。
1．35—30℃の温度条件は発根が早く生長の進行も早いが、最終の茎長は20％ほど短く、高芽の発生もあって栄養成長には不適であり、また花径が小さく淡色となって開花にも不適であった。２．20—15℃区は生育が大幅に遅れ、茎長も30％ほど短くて栄養成長に不適であった。３．30—25、25—20℃区は後者で開花がかなり遅れることとなったが、総じて栄養成長、開花の両面で良好であった。４．冬季における休眠芽の動きは15—10℃では全く起こらず、30—25℃では直ちに萌芽を開花した。このグループのデンドロビウムの開花の季節性は、冬季の低温に起因することで、基本的には休眠性を持たない植物であることが確認された。

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