

# 遮光, 低溫 處理가 Azalea 開花 影響

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## Effects of Shading, Chilling and Gibberellin Treatments on the Flowering of Azalea (*Rhododendron* spp.)

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Azalea 遮光, 低溫 處理가 開花反應 開花期間 開花數 遮光處理 開花數 遮光 開花期間 2 低溫處理 'Inga' 'Ripple' 開花所要日數 開花數 組合處理 低溫處理後 遮光處理가 'Inga' 'Ripple' 開花所要日數 開花數 組合處理, 'Reinhold Ambrosia' 開花所要日數 開花期間 開花數 遮光 處理濃度 'Inga' 'Ripple' 'Reinhold Ambrosia' 開花所要日數가 開花期間 가 遮光 GA3 組合處理 3 開花所要日數, 開花數 가 遮光 GA3 azalea 開花所要日數, 開花數 가 開花所要日數

This research was conducted to control flowering of azalea (*Rhododendron* spp.) by shading, chilling and gibberellin treatments. Higher shading among treatments resulted in extended duration of flowering (DF) and increased number of flowers (NF) in all varieties tested. Number of days to flower (NDF) was increased in 'Ripple' by shading treatment, but this was not affected in other two varieties tested. Chilling treatment increased NDF and NF in 'Inga' and 'Ripple'. This effect was vice verse in 'Reinhold Ambrosia' resulting in decreased NDF. Chilling treatment followed by high shading increased NDF and shortened DF in 'Inga' and 'Ripple', but that extended NDF and DF and increased NF in 'Reinhold Ambrosia'. In flowering response to GA3 higher concentration among treatments resulted in decreased NDF and extended DF in 'Ripple' and 'Reinhold Ambrosia', but this did not affect in 'Inga'. Combined treatment of shading and GA3 resulted in decreased NDF and increased NF. These results indicated that treatments of shading, chilling and gibberellin to azalea extended DF and increased NF, but NDF appeared to different according to varieties.

**Key words** : azalea, control of flowering, shading, chilling, gibberellin

I.

Azalea 盆花用 育成 花色  
 , , , , 가 가  
 가 (農林水産部,  
 1996). 盆花類中 poinsettia Chry-  
 santhemum 3  
 가 盆花類中 .  
 azalea 花色 形  
 態 青色 黃色  
 (Larson, 1993).  
 Azalea 營養生長期 生殖生長期가  
 4~5 新梢가 伸長 6~7 花  
 芽分化가 가  
 花器官 分化 小花가  
 (小西 等, 1988). 花芽形成  
 溫度(Pettersen, 1972; Shanks and Link, 1968),  
 日長(Criley, 1969; Pettersen and Kristoffersen,  
 1968), 生長調節物質(Boodley and Mastalerz, 1959;  
 Larson, 1993) 新梢 生育 等  
 溫度가 가 (小西 等, 1988)  
 . 長日條件 花芽分化  
 18- 25°C (Pettersen and Kristoffersen,  
 1968; Shanks and Link, 1968), 15°C  
 品種 花芽分化가  
 (Pettersen, 1972). 花芽分化 適溫  
 20- 25°C  
 恒溫 夜間溫度가 4~6°C 變溫處理가  
 效果的 (Larson and Biamonte, 1972).  
 花芽分化가 新梢  
 休眠 促成栽培  
 休眠打破 休眠打破 休  
 眠打破 遮光, 低溫 GA 處理가 休  
 眠打破 (Larson, 1992). 遮光  
 處理 Sweet(1960) 'Hinodegiri'  
 遮光率 가  
 . 休眠打破  
 가 가 低溫要求  
 4~10°C 20~40  
 가 (小西 等, 1988),

가 (Jorgensen, 1969).

azalea 休眠打破

生長調節物

質 GA3가 (Larson,  
 1992). 休眠打破 效果 Boodley  
 and Mastalerz(1959) 'Hexe' 'Sweetheart  
 Supreme' GA3 低溫代替  
 가 .  
 azalea 無加溫栽培 3  
 6 , 施設內 促成栽培 12 3  
 , 7 11 花芽分化期 休  
 眠期 極早生種  
 7 11 端  
 境期 azalea 作付體系  
 發達 休眠打破 花芽

가 azalea 遮光,

低溫 GA3 開花反應 調查

azalea 盆花生産 開花時期 , 花 品質

II.

azalea

'Inga', 'Ripple' 'Reinhold Ambrosia' 3  
 1994 2  
 插木苗 15 cm peat moss(4)  
 : (2) : (2) : (1) : (1)  
 . 施肥  
 500 1 50 ml 土壤灌注  
 .  
 azalea 花芽形成 遮光  
 處理 'Inga' 7 5 , 'Ripple' 8 2 ,  
 'Reinhold Ambrosia' 8 31 , 開花  
 期間 , 開花數 開花期間  
 . 花徑  
 . 開花所要日數 最終摘心(3  
 20 ) ,  
 15 .  
 'Inga', 'Ripple', 'Reinhold Ambrosia'  
 摘心 1993 11 20 2  
 1994 1 20 1994 3 20 3

遮光, 低溫 GA3 處理 花芽  
 分化가 , 遮光處理 花芽分化가  
 60  
 60% 80% 遮光處理區  
 遮光期間 經時的 平均照度  
 가 65.8 k Lux, 60% 遮光 26.7 k Lux  
 80% 遮光 12.8 k Lux ,  
 遮光 1  
 低溫處理 花芽分化가 低溫處理  
 1 17±1℃ , 低溫處理 3 8±1℃  
 ( 1), 低溫處理 施設內(1.7×1.7 m)  
 照明 60 W 1 10 (06:50~17:20)  
 . GA3 處理 花芽分化 1  
 2 500 mg/L 1,000  
 mg/L 10 ml 藥液  
 ( 2).

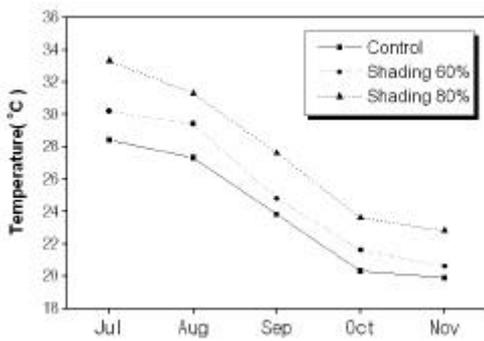


Fig. 1. Average air temperature during the experiment of azalea

III.

1. 遮光處理

開花反應

開花所要日數  
 Reinhold Ambrosia'가 256 가  
 'Ripple' 183 ,  
 'Inga' 126 . 3 60%,  
 80% 遮光處理 'Inga' 'Reinhold  
 Ambrosia'  
 'Ripple' 15 開花所要日數가  
 . 開花期間

Table 1. Shading and chilling treatments of azaleas 'Inga', 'Ripple' and 'Reinhold Ambrosia'.

Cultivars	Time of treatments		
	Pre-chillingZ	Chillingy	Shading
Inga	Jul. 6~Jul. 13	Jul .13~Aug .3	Aug. 3~Oct. 3
Ripple	Aug.3~Aug.10	Aug.10~Aug.31	Aug.31~Oct.31
Reinhold	-	Sep. 1~Sep. 22	Sep.22~Nov.22
Ambrosia			

zPre-chilling was treated for one week at 17±1℃.

yChilling was treated for three weeks at 8±1℃.

Table 2. Shading and gibberellin treatments of azaleas 'Inga', 'Ripple' and 'Reinhold Ambrosia'.

Cultivars	Shading	GA3 treatment	
		first	second
Inga	Jul. 7~Sep.7	Jul. 7	Jul. 14
Ripple	Aug.4~Oct.4	Aug.4	Aug.11
Reinhold	Sep.1~Nov.1	Sep. 1	Sep. 8
Ambrosia			

z Concentration of GA3 for the first treatment was 500 mg/L and 1,000 mg/L for the second treatment.

開花數 遮光 80% 處理 'Inga'  
 'Reinhold Ambrosia' 가 'Ripple'  
 遮  
 光 60% 處理 80% 處理 開花所要日  
 數, 開花期間 開花數  
 . 開花數 花徑 遮光處  
 理 ( 3).  
 Pettersen(1968) 'Reinhold  
 Ambrosia' 'Red Wing' 遮光率 가  
 新梢 數 重量 新梢長 葉  
 數가 가  
 同化產物

Table 3. Effect of shading on flowering of azalea cultivars.

Cultivars	Shade (%)	Days to flowering	Flowering period	No.of flowers /flower bud	No.of flowers /pot	Flower diameter (cm)
Inga	0	126 az	Jul.24~Aug. 8	1.2 a	25.5 b	7.8 a
	60	125 a	Jul.23~Aug. 9	1.4 a	26.2 b	7.7 a
	80	124 a	Jul.22~Aug. 8	1.4 a	28.2 a	7.7 a
Ripple	0	183 b	Sep.19~Oct.14	0.7 a	39.5 a	6.5 a
	60	199 a	Oct. 5~Oct.30	0.6 a	38.8 a	6.4 a
	80	198 a	Oct. 4~Oct.30	0.7 a	40.1 a	6.4 a
Reinhold	0	256 a	Dec. 1~Dec.16	1.5 a	14.8 b	8.0 a
Ambrosia	60	261 a	Dec. 6~Dec.21	1.7 a	15.3 b	7.7 a
	80	26 4a	Dec. 9~Dec.27	1.8 a	18.1 a	7.7 a

z Mean separation in columns by Duncan's multiple range test, 5% level by cultivars

花發育 所要日數  
花 (Bodson, M. 1983).  
Criley(1969)가  
花芽分化 (1983) 'Beny Kirishima' 品種 掘口 等 花芽形成 遮光處理  
65~70% 遮光 93~  
95% 遮光 가  
遮光處理  
開花期間 開花數 開花  
2. 低溫處理 開花反應.  
低溫處理가 azalea 開花  
開花所要日數 對照區 'Inga'  
'Ripple' 39 22  
'Reinhold Ambrosia' 10  
開花數 'Inga' 25.5  
'Ripple' 39.5 79.6  
'Reinhold Ambrosia'  
( 4).

Table 4. Effect of chilling on flowering of azalea.

Cultivars	Treatment	Days to flowering	Flowering period	No.of flowers /flower bud	No.of flowers /pot	Flower diameter (cm)
Inga	nonz chilling	126 by 165 a	Jul.24~Aug. 8 Sep.1~Sep.13	1.2 b 1.9 a	25.5 b 42.5 a	7.8 a 7.7 a
	Ripple	non chilling	183 b 205 a	Sep.19~Oct.14 Oct.11~Nov.2	0.7 b 1.3 a	39.5 b 79.7 a
Reinhold	non	256 a	Dec. 1~Dec.16	1.5 a	14.8 a	8.0 a
Ambrosia	chilling	246 b	Nov.21~Dec.3	1.6 a	17.1 a	7.3 b

z Temperature for chilling was 8±1°C for 3 weeks.

y Mean separation in columns by cultivars by Duncan's multiple range test, 5% level.

3 開花期 25.5 43.7 가  
 間 3 , 開花數 가 開花所要日數 39 ,  
 7 24 9 1 .  
 'Ripple' 'Inga' 가  
 80% 遮光 低溫處理 가 가  
 39.5 60.5 가  
 (1969) Reinhold Ambrosius' 'Red Wing' 開花所要日數 29 延長 .  
 9-12℃ 가 3-6℃  
 'Reinhold Ambrosia' 'Inga', 'Ripple'  
 80% 遮光 低溫處理 開花所  
 3 要日數가 13 ,  
 12 1 80% 遮光 低溫處理區  
 11 11 19 . 開花數  
 2 9.6  
 極早生種 'Inga' 早生種  
 'Ripple' 晚生 가 .  
 種 中晚生種 'Reinhold Ambrosia' 'Inga' 'Ripple' 遮光  
 低溫 開花數 가 , 開花  
 所要日數  
 晚生種 中晚生種  
 極早生,  
 早生種 品種 'Reinhold Ambrosia'  
 開花所要日數  
 'Inga' 'Ripple'  
 開花期間 ,  
 小西 等(1988) ( 5).  
 가 極早生種 早 遮光處理 가  
 生種 品種 가 가  
 遮光處理

3. 遮光 低溫 組合處理 開花反應

'Inga' 開花數 80% 遮光 低溫處理 가 遮光

Table 5. Effects of shading and chilling treatments on flowering of azalea.

Cultivars	Treatments		Days to flowering	Flowering period	No.of flowers /flower bud	No.of flowers /pot	Flower diameter (cm)
	Shading (%)	Chilling					
Inga	0	non	126 bz	Jul.24~Aug. 8	1.2 b	25.5 b	7.8 a
	60	treated	168 a	Sep. 4~Sep.17	2.0 a	42.8 a	7.7 a
	80	treated	165 a	Sep. 1~Sep.18	2.1 a	43.7 a	7.6 a
Ripple	0	non	183 b	Sep.19~Oct.14	0.7 b	39.5 b	6.5 a
	60	treated	211 a	Oct.17~Nov. 8	1.1 a	63.8 a	5.7 b
	80	treated	212 a	Oct.18~Nov.10	1.0 a	60.5 a	5.6 b
Reinhold Ambrosia	0	non	256 a	Dec. 1~Dec.16	1.5 b	14.8 b	8.0 a
	60	treated	244 b	Nov.19~Nov.30	2.1 a	23.1 a	7.0 b
	80	treated	243 b	Nov.18~Nov.29	2.1 a	24.4 a	6.9 b

z Mean separation in columns by cultivars by Duncan's multiple range test, 5% level

Table 6. Effect of three levels of gibberellin on flowering of azalea.

Cultivars	GA3 (mg/L)	Days to flowering	Flowering period	No.of flowers /flower bud	No.of flowers /pot	Flower diameter (cm)
Inga	0	126 az	Jul.24~Aug. 8	1.2 b	25.5 b	7.8 a
	500	126 a	Jul.24~Aug.10	1.5 a	29.9 a	7.7 a
	1,000	125 a	Jul.23~Aug. 8	1.5a	31.1 a	7.6 a
Ripple	0	183 a	Sep.19~Oct.14	0.7 b	39.5 b	6.5 a
	500	171ab	Sep. 7~Oct. 1	0.7 b	38.2 b	6.2 a
	1,000	166 b	Sep. 2~Sep.26	0.9 a	43.6 a	6.1 a
Reinhold	0	256 a	Dec. 1~Dec.16	1.5 a	14.8 a	8.0 a
Ambrosia	500	253 a	Nov.28~Dec.19	1.5 a	15.6 a	7.9 a
	1,000	225 b	Oct.31~Nov.24	1.5 a	15.7 a	7.9 a

z Mean separation in columns by cultivars by Duncan's multiple range test, 5% level.

4. Azalea  
6 開花所要日數  
Ripple' 183  
GA3 1,000 mg/L 166 17  
, Reinhold Ambrosia' 256  
GA3 1,000 mg/L 225 31  
開花所要日數 Inga'  
가 Ripple' Reinhold Ambrosia'  
GA3 가 開花所要日數  
開花期 Inga' 15  
GA3 1,000 mg/L 17 2 가 ,  
'Reinhold Ambrosia' 15 GA3  
1,000 mg/L 24 9 가 Ripple'  
GA3 開花  
期 Inga'  
, 'Ripple'  
'Reinhold Ambrosia'  
가 12 1 GA3 1,000 mg/L 10  
31  
開花數 'Inga' 1 花芽 總開花數  
가 開花數가 25.5  
GA3 1,000 mg/L 31.1 5.6 가 가

, 'Ripple' 39.5  
GA3 1,000 mg/L 43.6 4.1 가 가  
, 'Reinhold Ambrosia' 가  
Larson Thorne(1985) GA4+7 1,000 mg/L  
가 8.8°C 開花所要日數  
'Dogwood' 1 , Hellmut Vogel' 22 , 'Red  
Wing' 3 'Oregon Alaska'  
2 , 'Prize'  
가 가  
GA4+7 가  
, 'Dorothy Gish' 15°C  
GA3 4.4°C  
6 GA3가  
4.4°C 12-34  
4.4°C  
GA3가  
(Martin et al., 1960).

5. 遮光 GA3 組合處理 反應.

Azalea 遮光 GA3 組合處  
理 7 開花所要日數  
'Reinhold Ambrosia' 256  
遮光 80% GA3 1,000 mg/L 240 가  
16 , 'Ripple'  
183 60% GA3 1,000 mg/L

Table 7. Effects of shading and GA3 treatments on flowering of azalea.

Cultivars	Treatment		Days to flowering	Flowering period	No.of flowers /flower bud	No.of flowers /pot	Flower diameter (cm)
	Shading	GA3 (mg/l)					
Inga	0%	0	126 az	Jul.24~Aug. 8	1.2 b	25.5 b	7.8 a
	60%	500	124 b	Jul.22~Aug. 9	1.5ab	28.7ab	7.6ab
		1,000	123 b	Jul.21~Aug. 8	1.7 a	31.1ab	7.5ab
		500	123 b	Jul.21~Aug. 9	1.7 a	34.7 a	7.5ab
	80%	1,000	123 b	Jul.21~Aug. 9	1.8 a	34.8 a	7.4ab
Ripple	0%	0	183 a	Sep.19~Oct.14	0.7 b	39.5 b	6.5a
	60%	500	176ab	Sep.12~Oct. 8	0.6 b	38.3 b	6.1ab
		1,000	169bc	Sep. 5~Oct. 1	0.8 a	45.9 a	6.0ab
		500	178 b	Sep.14~Oct. 8	0.7 b	39.9 b	6.0ab
	80%	1,000	176ab	Sep.12~Oct. 7	0.8 a	44.3 a	6.0ab
Reinhold	0%	0	256 a	Dec. 1~Dec.16	1.5 b	14.8 b	8.0a
Ambrosia	60%	500	260 a	Dec. 5~Dec.21	1.7ab	17.7ab	7.7ab
		1,000	247 b	Nov.22~Dec.11	1.8 a	19.1 a	7.6ab
		500	252ab	Nov.27~Dec.20	1.9 a	18.1 a	7.6ab
	80%	1,000	240bc	Nov.15~Dec.10	1.9 a	18.2 a	7.6ab

z Mean separation in columns by cultivars by Duncan's multiple range test, 5% level

169 14 , 'Inga' 가 가 , 'Ripple' 39.5  
 3 . 開花所要日數 遮光 80% GA3 1,000 mg/L 44.3 4.8  
 'Reinhold Ambrosia' 遮 가 가 . 'Reinhold Ambrosia'  
 光 GA3 濃도가 'Inga' 14.8 遮光 80% GA3 1,000 mg/L  
 'Ripple' 開花所要日數가 18.2 3.4 가 가 .  
 . 'Inga', 'Ripple' 'Reinhold Ambrosia' 3  
 開花期間 'Inga' 'Ripple' 遮光 遮光 GA3 濃도가 1 花芽  
 80% GA3 1000 mg/L 開花數 가 가 가 ,  
 a' 'Reinhold Ambrosia' 'Inga' 가가  
 GA3 1,000 mg/L 25 10 . 'Inga', 'Ripple' 'Reinhold Ambrosia'  
 가 開花期 3 遮光處理 低溫  
 'Inga' 7 24 , 'Ripple' 9 GA3 1,000 mg/L 組合處理 開花數 開花  
 19 'Reinhold Ambrosia' 12 1 所要日數 (Fig. 2).  
 , 遮光 80% GA3 1,000 mg/L 3 遮光 80% 低溫處理  
 'Inga' 3 , 'Ripple' 7 遮光處理 開花數 가  
 'Reinhold Ambrosia' 15 , 遮光 80% GA處理  
 . 開花所要日數  
 'Inga' 'Riple' 遮光80%  
 遮光 80% GA3 1,000 mg/L GA3 開花所要  
 1 花芽 開花數가 가 34.8 9.3 가 日數가 가 'Reinhold Ambrosia'

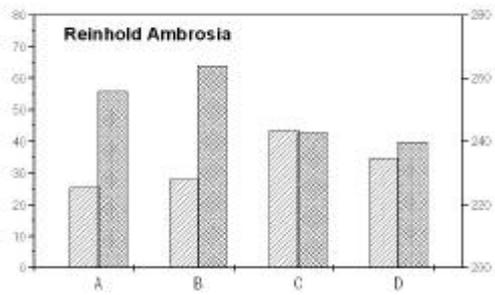
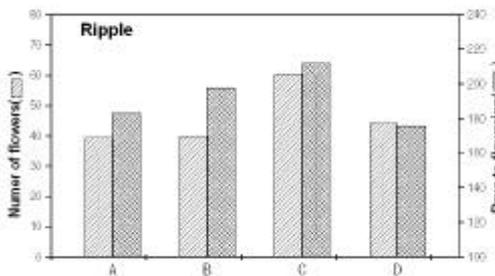
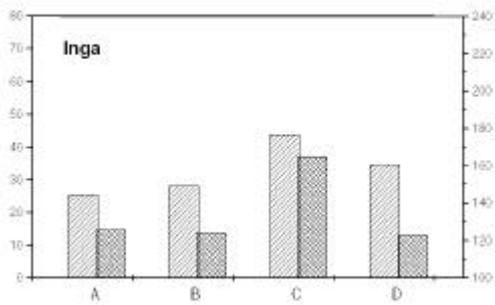


Fig. 2. Effects of shading, chilling, gibberellin, and reciprocal combination treatments on the flowering of azalea cultivars.

[A:control, B:shading(80%), C: shading (80%) + chilling (8 ± °C), D: shading(80%) + gibberellin(1,000 mg/l)].

遮光 80% 低溫處理 GA<sub>3</sub>處理  
 開花所要日數 遮光 低  
 溫處理 GA<sub>3</sub>處理 3 開花數  
 가 開花所要日數 'Reinhold  
 Ambrosia'

理 GA<sub>3</sub>處理 低溫處  
 GA<sub>3</sub>處理가 開花數  
 開花所要日數  
 GA<sub>3</sub> 가 低溫代替

Joiner (1983) 'Alaska' 開花所要日數가  
 GA<sub>3</sub> 3,000 mg/L 處理 低溫處理(4.4°C)

, Martin (1960)  
 'Dorothy Gish' GA<sub>3</sub> 500 mg/L 1,000  
 mg/L 處理 低溫(4.4°C) 6  
 GA<sub>3</sub>處理가 低溫處理 1  
 2~34 , GA<sub>3</sub>處理

가

遮光 GA<sub>3</sub> 組合處理

遮光

GA<sub>3</sub>

濃度가 'Inga' 'Reinhold Ambrosia'  
 開花所要日數 花徑 開花期間  
 總 開花數 가

1996

### 參 考 文 獻

Bodson, M. 1983. Effect of photoperiod and irradiance on floral development of young plants of a semi-early and a late cultivar of azalea. *J. Amer. Soc. Hort. Sci.* 108(3): 382-386.

Boodley, J.W., and J.W. Mastalerz. 1959. The use of gibberellic acid to force azaleas without a cold temperature treatment. *Proc. Amer. Soc. Hort. Sic.* 74: 681-685.

Criley, R.A. 1969. Effect of short photoperiods, cycocel, and gibberellic acid upon flower bud initiation and development in azalea 'Hexe'. *J. Amer. Soc. Hort. Sic.* 94(4): 392-396.

堀口輝夫, 伊丹 清, 坂口 進. 1983. ベニキリシマツツジの年内開花技術(1). 農業および園藝 58: 453-456.

Joiner, J.N., O. Washington, C.R. Johnson, and

- T.A. Nell. 1983. Effect of exogenous growth regulators on flowering and cytokinin levels in azaleas. *Scientia Hort.* 18: 143-151.
- Jorgensen, S. 1969. The effect of storage temperatures, short day treatment, and B-Nine on the flowering of thirteen cultivars of greenhouse azaleas. *Acta Hort.* 14: 17-26.
- 小西國義, 今西英雄, 五井正憲. 1988. 花卉の開花調節. 養賢堂. 東京. p. 274-283.
- Larson, R.A. 1992. *Introduction to Floriculture*. Academic Press. New York.. p. 223-248.
- Larson, R.A. 1993. *Production of Florist Azaleas*. Timber press. Hong Kong. p. 55-71.
- Larson, R.A., and R.L. Biamonte. 1972. Response of azaleas to precisely controlled temperatures. *J. Amer. Soc. Hort. Sci.* 97(4): 491-493.
- Larson, R.A., and C.B. Thorne. 1985. Environmental versus chemical manipulation of azalea flowering. *North Carolina Flower Growers' Bull.* 29(2): 1-7.
- Martin, L.W., S.C. Wiggans, and R.N. Payne. 1960. The use of gibberellic acid to break flower bud dormancy in azaleas. *Proc. Amer. Soc. Hort. Sci.* 76: 590-593.
- 農林水産部. 1995, 1996. 花卉栽培現況.
- Pettersen, H. 1968. Effect of light and temperature on the number of shoots after pinching of azaleas and on the subsequent growth of the shoots(English summary). *Norges Landbrukshogskole, Vollebakk Medling.* 134: 10-20.
- Pettersen, H. 1972. The effect of temperature and daylength on shoot growth and bud formation in azaleas. *J. Amer. Soc. Hort. Sci.* 97(1): 17-24.
- Pettersen, H., and T. Kristoffersen. 1968. The effect of daylength and temperature on flowering in the azalea cultivars 'Red Wing' and 'Reinhold Ambrosius'. *Acta Hort.* 14: 27-38.
- Shanks, J.B., and C.B. Link. 1967. Some factors affecting growth and flower initiation of greenhouse azaleas. *Proc. Amer. Soc. Hort. Sci.* 92: 603-614.
- Sweet, C.V. 1960. The effect of shade treatments on frost hardiness and flowering of azaleas. *Georgia Agric. Exp. Station Circular N.S.* p. 18-19.