



Primula Production Tutorial

Sakata Ornamentals



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Primrose Trivia

Native to western and southern Europe

Usually heralding spring, the primrose often signifies eternal love, youth and purity. They were sometimes used in love potions.



Sakata Seed Primula genetics

- Sakata offers a wide selection of *Primula acaulis* and polyanthus genetics with outstanding features and benefits.
- More than 50 years of breeding experience with research stations in both Japan and Denmark, offering options to growers in both warm and cool climate areas.



Danova Mix



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Primula Breeding Goals

- Uniformity in plant habit
- Excellent seed quality
- Compact, strong and healthy plants
- Dark green leaves
- A uniform rosette without side shoots
- Large flowers
- Clear colors
- Non stretching flower stems
- Short flowering window



Danova Yellow w/Eye



Danessa

Primula acaulis F1

Annual

The most early series on the market that flowers 3 weeks earlier than Danova and is ideal for autumn flowering.

- Does not require cold to initiate* flowers.
- Three weeks earlier than Danova making possible production for early autumn sales.
- Bred for uniform plant habit, consistent flower size and quality.
- High usable plug count to improve profit.
- Outstanding color for pots, gardens and patio pots.

*maximum temperature of 78°F



Mix



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Pageant

Primula acaulis F1

Annual

Pageant is an early-flowering series and bred to flower with a minimum cold requirement. It is ideal for autumn and the beginnings of winter in mild winter areas.

- Pageant flowers from October to December.
- Very uniform flowering and plant growth.
- Very compact plants with small leaves making high density production possible.
- Ideal for early sales in packs.
- Very economical and well-known among growers.
- Extra early flowering means a substantial savings in heating costs.



Apricot



Blue



Bright Pink



Bright Rose Shades



Deep Carmin Rose



Lemon Yellow



Mid Blue



Red Bicolor



Rose Pink
Bicolor



Scarlet



White with
Yellow Eye



Yellow Shades



Mix

Danova

Primula acaulis F1

Annual

Danova is the most uniform flowering series on the market and the best selection for sales early and mid-season sales.

- World leading series for sales at the beginning of the season.
- The industry leader that others try to copy.
- It offers the highest percentage of salable plants
- Extremely uniform plant habit.
- Consistent large flower size of 2 - 2½ inches / 5-6 cm in diameter.
- Short flowering window.
- The largest range of pure and attractive colors which easily makes the creation of salable mixes.
- Very high germination.
- High usable plug count to improve profitability.
- Outstanding color for pots, gardens and patio pots.



Grower's Select Mix



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Primula acaulis Danova Series

- Center flowering for a beautiful bouquet of large magnificent flowers.
- Irresistible impact for impulse sales!



Danova

Primula acaulis F1

Annual



Bicolor Rose & White



Blue



Cherry with Edge



Copper



Cream Yellow



Golden Yellow



Lemon Yellow



Light Violet



Lime



Orange Yellow



Pink Imp.



Purple



Red



Red & Rose Shades



Red with Yellow Edge



rose



Rose Lavender Shades



Salmon Orange



Scarlet



Sky Blue



Velvet Red



White



Wine Red



Yellow with Eye

Primula Danova Choice is a selection of the best matching colors within the series selected for habit and flowering.

“Core colors that perform perfectly together”.



Bicolor Rose & White



Blue



Lemon Yellow



Orange Yellow



Pink



Bicolor Purple



Red



Sky Blue



White



Yellow with Eye



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Danova Bicolor Mix

Primula acaulis F1

Annual

Increase your selection of unique colors. Slightly more vigorous than Danova. Bicolors have the same consistent earliness and quality as Danova.

- For early and mid-season sales bred in Denmark.
- Attractive and vibrant bicolors to compliment the solid colors in the Danova series.
- Consistent flower size of 2-2½ inches / 5-6 cm. in diameter.
- The same excellent seed quality as Danova.
- The same exceptional earliness and uniformity as Danova.
- Slightly more vigorous plant compared to Danova.
- Outstanding color for pots, gardens and patio pots.



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Daniella

Primula acaulis F1

Annual

Daniella has the same quality standard as Danova but with a later flowering. Daniella is recommended for growers who wish to sell later in the season and is the best mid season series available on the market today.

- A high quality leading series for mid-season sales.
- Bred to flower 2 weeks later than Danova.
- The same excellent seed quality as Danova
- The same exceptional uniformity and plant habit as Danova.
- Consistent large flower size, 2-2½ inches / 5-6 cm in diameter.
- Very attractive color selection.



Apricot



Blue



Cream Yellow



Neon Rose



Pink



Rose



Rose Bicolor



Scarlet



White



Yellow



Mix



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Rosanna

Primula acaulis F1

Annual

Unique produce for gift pot sales.

- Rose bud shaped flowers with the same high percentage of salable plants.
- Large beautiful flowers for impulse sales.
- Unique product that attracts attention in mixed containers or as a gift pot.
- Bright attractive color range.



Apricot Shades



Pink Shades



Rose Pink Shades



Scarlet Imp.



White Imp.



Yellow Shades

SuperNova

Primula polyantha F1

Annual

Suitable for container sales or as a garden plant. SuperNova provides uniform results and an excellent show of color. An F1 hybrid with high uniformity and vigor.

- Early flowering for early autumn impulse sales.
- Spring flowering under cool temperature conditons.
- Large and showy umbels and multiple, robust stems.
- Suitable for both autumn and spring depending on the climate and cultivation method.



Blue



Cream



Golden Yellow



Pink



Purple Bicolor



Red



Rose Bicolor



Sky Blue



White Imp.



Yellow



Mix



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Fire

Primula polyantha F1

Annual

This type of polyanthus is truly unique and showy and a great consumer favorite.

- The outside petals are a beautiful intense red contrasted by a brilliant intense gold center.
- SuperNova Fire flowers open 7-11 days later than the other SuperNova colors.
- The plant habit is thinner.
- Ideal for containers!



Fire



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Primula polyanthus SuperNova



SuperNova Purple Bicolor



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Primula polyanthus SuperNova

- Early season F1 hybrid, bred in Denmark, that flowers along with the Dawn series.
- Highest number of marketable plants.
- Large showy umbels on strong, multiple stems.
- Wide range of color choice.
- Continuous, colorful flowering.
- Multiple uses, including pot plants, patio containers and garden plants.
- Well suited for landscaping and winter flowering in moderate climatic regions.
- Easy maintenance for landscape gardening.



SuperNova Red



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Primula polyanthus SuperNova and light level

Flower stem elongation is a function of genetics and light intensity.



SuperNova Blue, Seattle, Washington



SuperNova Blue, Morgan Hill, California



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Stage 1 (germination)

- Days 1-14
- Well aerated media, a 60% fine peat/25% perlite/15% vermiculite blend works well. EC <0.6 mmhos (1:2 slurry).
- pH 5.5-6.0
- Optimum temperature is 59°F/15°C day and night.
- Keep the media moderately moist for the first week. If germinating in the greenhouse, apply a light cover of medium vermiculite to maintain sufficient humidity.
- Primula requires light to germinate.
- In the greenhouse supply 400-1,000 foot candles/4,300-11,000 lux. If using a germination chamber, supply 10-100 foot candles/110-1,100 lux of light to improve germination and prevent stretch.
- Seed germinates in 5-7 days depending on conditions.



Vermiculite Covering



Vermiculite should be sized (2-3mm) with sieve (mesh) before cover



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Stage 2 (until first true leaf development)

- Days 15-29
- When cotyledons are fully expanded, reduce humidity levels to 70% but do not allow the media to dry out. A light mist 2-3 times a day is beneficial to keep the plants cool.
- Supply a light level between 1,000-2,000 foot candles/11,000-22,000 lux to avoid damaging the tender seedlings.
- Fertilize 50 ppm N using a well balanced calcium nitrate based formulation to prevent marginal burn of cotyledons.
- Maintain soil EC <0.6 mmhos (1:2 slurry) and <10 ppm NH₄.



Irrigation timing



Water applied regularly without waiting for the surface to become dry.



Water applied after the media surface became a light tan color



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Stage 3 (true leaf development)

- Days 30-45
- The first true leaves have formed.
- Maintain cool temperatures (59-65°F/15-18°C) and sufficient humidity.
- Fertilize the plants with 50-75 ppm N as needed to maintain EC level around 0.8 mmhos (1:2 slurry).
- Alternating between a Cal/Mag formulation and 20-10-20 works well to maintain optimum pH.
- Potassium is important for strong growth. Fertilizer formulations like 15-3-20 and 15-5-25 are good options.



Plug Phase: Stage 4 (toning for transplant or shipping)

- Days 46-50
- The plants have 3-4 true leaves and are now ready for transplanting.
- Applying 200 ppm N a week before transplanting helps the plants make the transition from the plug tray to the final container.



Sowing under high temperature conditions – key points

- Maintain seedling house as cool as possible.
- Use white vermiculite to reflect heat.
- Use fog system or evaporative cooling to reduce temperature.
- Use white colored trays.



Black plastic plug trays raise media temperature by 6-12°F/ 3-6°C



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Transplanting - Media

- Use a well-aerated sterile media that is high in organic matter.
- Optimum pH is between 5.5-6.0
- Optimum light level is 2,500-3,000 foot candles/27,000-32,000 lux. Do not exceed 3,500 foot candles/37,500 lux.
- The planting depth should be the same as the seedling flat to avoid crown rot and other diseases.



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Benefit of a well-aerated media



Long fiber peat vs. Peat lite Mix



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Benefit of a well-aerated media



Peat moss with large particles of pumice creates a well-aerated media with healthy thick white roots for optimum nutrient uptake.



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Ellepot showing excellent root development



Ellepots can be used for making mixed containers with spring flowering bulbs or for landscape customers.



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Iron deficiency due to high pH



Optimum pH is 5.5-6.0.

High pH (>6.2) induces iron deficiency characterized by chlorosis of upper foliage.

Low pH (<5.5) results in excess zinc characterized by leaf edge necrosis of lower foliage.



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HOW HOT!!



It is over 104°F / 40°C at quarter past two.



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Shading Control



Adjusting light levels by plug stage. Ideally using a retractable shade system allow for maximum light availability and more compact plants.



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Light measurements

- Foot candles are a measure of how many lumens fall in a square foot. Lux is a measure of how many lumens fall in a square meter. Both read light in terms of its brightness or how the human eye perceives light.
- Watts per square meter measures light energy.
- Light, when considered as a wavelength or frequency can be viewed as a stream of particles or photons. Units can be expressed in moles (photons) per square meter per second ($\text{mol m}^{-2} \text{s}^{-1}$). Moles measure how plants perceive light, and best calculates the light calories received throughout the day.



Light Quality

- Optimum light level is 2,500-3,000 foot candles/27,000-32,000 lux. Do not exceed 3,500 foot candles/37,500 lux.
- Target 10 moles of light per day



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Light Measurement Tool

- The Weather Tracker, by Spectrum Technologies, records high and low temperatures and the moles of light received in a 24 hour period.



Fertilizer

- Select a cal/mag fertilizer, such as 15-2-20, at 100-150 ppm N to supply major and minor elements.
- Alternate with 20-10-20, as needed, to maintain optimum pH.
- Supplemental magnesium in the form of MgSO_4 at 30 ppm (4 oz/100 gallons) is recommended in areas with high calcium in the irrigation water.
- Potassium promotes high bud count and a more compact plant. It is recommended to supply a N:K ratio of 1:1.5



Nitrogen excess



Excess nitrogen results in overgrowth of plants.



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Calcium deficiency

- Calcium is taken up passively via transpiration instead of being actively absorbed. Therefore, it is important to promote high transpiration activity.
- Low light and cool conditions with high atmospheric humidity results in less transpiration pull.
- A media that is poorly aerated or overly saturated produces less root hairs, resulting in less calcium uptake.
- Option to apply calcium chloride at 200-400 ppm Ca with a spreader-sticker compatible with primula.



Magnesium deficiency

- Magnesium is a macro element that is translocated from lower leaves to upper leaves if a deficiency occurs.
- Characterized by interveinal chlorosis (often a Christmas tree shape) ending in necrosis beginning at the leaf margin.
- Supply magnesium in the fertilizer or as a periodic drench of $MgSO_4$ every 14 days.



Stages of development

- **Juvenile Stage** - plant is not capable of responding to a flowering stimulus.
- **Mature Stage** – plant is capable of responding to a flowering stimulus.
- Often measured by the number of leaves that must be unfolded.
- In recent years breeders have targeted shorter juvenile periods to reduce crop times.



Juvenile Phase – Sowing to 6-8th true leaf stage, around 12 weeks



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Initiation stage, well rooted with 6-8 leaves



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Flower bud initiation

- When the plants have 6-8 leaves and a well-established root system, they are receptive to flower bud initiation.
- The standard recommendation is to lower the temperature to 45-50°F for 5-9 weeks (depending on cultivar grown).
- Research has shown that *primula acaulis* is both a facultative long day plant and facultative irradiant plant.
- Exposing the plants to a 14 hour day length, 10 moles of light and 55-60 F induces quicker flower initiation, reducing crop time.



Indication of flower bud initiation



- A pale green color on the new leaves is a sign of flower bud initiation.
- Often, a grower mistakes this for underfed plants; especially during hot summer weather.
- It is best to wait 1 week to see. If the pale green color is due to flower bud initiation, as it recovers a normal green shade before applying extra fertilizer.



Indication of flower bud initiation



- A pale green color on the new leaves is a sign of flower bud initiation.
- These plants had insufficient plant bulking in the juvenile stage.
- A chemical growth regulator application at this point would be inappropriate.



Traditional Schedule for Sakata Primula

Schedule in Weeks	Plug: 59°F / 15°C	Vegetative: 59°F / 15°C	Vernalization: 39 – 45°F / 4-7°C	Flowering: 52 – 57°F / 11-14°C
Danessa (acaulis)	8	4	3*	3
Pageant** (acaulis)	8	4	5	3
SuperNova (polyanthus)	8	4	5	3
Danova (acaulis)	8	4	7	3
Daniella – Rosanna (acaulis)	8	4	9	3

* initiation occurs if the day temperature does not exceed 78°F/ 26°C

** for Pageant bicolors follow schedule for Danova



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Effect of light intensity and photoperiod on flowering response in primula

- In the following slides one will see the effects of light intensity and photoperiod on primula flowering. This creates various opportunities for growers and markets.
- Option to **reduce time to flower in cool regions** where greenhouse space is at a premium.
- Option to **expand the primula market into warmer climatic areas** that do not traditionally produce primula.
- Option to **sow primula later in the season** for late spring sales



Days to flower initiation in *Primula acaulis* 'Danova type'

		<u>Irradiance (mol day⁻¹m²)</u>		
<u>Photoperiod</u>		2	10	18
(hours)				
46°F/8°C	8	201 days	49 days	42 days
	11	80 days	43 days	35 days
	14	58 days	36 days	30 days
54°F/12°C	8	73 days	35 days	35 days
	11	60 days	33 days	28 days
	14	50 days	33 days	33 days

Days to flower initiation in *Primula acaulis* developing at 46°F/8°C or 54°F/12°C and 8,11, or 14 hour photoperiod at 2, 10 or 18 mol day⁻¹m² .

Research by Dr. Meriam Karlsson, University of Alaska.



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Days to flower initiation in *Primula acaulis* 'Danova type'

		<u>Irradiance (mol day⁻¹m⁻²)</u>		
<u>Photoperiod</u>		2	10	18
(hours)				
60°F/16°C	8	47 days	39 days	43 days
	11	45 days	33 days	37 days
	14	44 days	26 days	32 days
68°F/20°C	8	108 days	52 days	56 days
	11	71 days	42 days	44 days
	14	73 days	34 days	48 days

Days to flower initiation in *Primula acaulis* developing at 60°F/16°C or 68°F/20°C and 8,11, or 14 hour photoperiod at 2, 10 or 18 mol day⁻¹m⁻²

Research by Dr. Meriam Karlsson, University of Alaska.



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Days to flower color from transplant in *Primula acaulis* 'Danova type'

		<u>Irradiance (mol day⁻¹m²)</u>		
<u>Photoperiod</u>		2	10	18
(hours)				
46°F/8°C	8	143 days	132 days	101 days
	11	133 days	126 days	86 days
	14	142 days	89 days	85 days
54°F/12°C	8	118 days	88 days	()
	11	120 days	83 days	85 days
	14	112 days	81 days	87 days

Days to flower color from transplant in *Primula acaulis* developing at 46°F/8°C or 54°F/12°C and 8,11, or 14 hour photoperiod at 2, 10 or 18 mol day⁻¹m² for 8 weeks and moved to 60°F/16°C, 11 hour day length and 10 mol day⁻¹m² to complete the development.

Research by Dr. Meriam Karlsson, University of Alaska.



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Days to flower color from transplant in *Primula acaulis* 'Danova type'

		<u>Photoperiod</u>	<u>Irradiance (mol day⁻¹m⁻²)</u>		
		(hours)	2	10	18
60°F/16°C	8		104 days	90 days	86 days
	11		103 days	86 days	87 days
	14		103 days	83 days	87 days
68°F/20°C	8		126 days	121 days	110 days
	11		120 days	112 days	96 days
	14		115 days	86 days	105 days

Days to flower color from transplant in *Primula acaulis* developing at 60°F/16°C or 68°F/20°C and 8,11, or 14 hour photoperiod at 2, 10 or 18 mol day⁻¹m⁻² for 8 weeks and moved to 60°F/16°C, 11 hour day length and 10 mol day⁻¹m⁻² to complete the development.



Flower initiation recommendation

- For rapid flower bud initiation, a long day length (14-16 hours) is beneficial. When natural day length is less than 12 hours, extending the day to 16 hours or utilizing a 4-hour night interruption at a minimum of 10 foot candles/110 lux* is recommended. At 54°F/12°C primula initiated earlier at 10 moles of light across all photoperiods.
- Primula flower initiation is a function of plant age and stimuli to transition the plant from a juvenile phase into a reproductive mode. Flower initiation was identified in plants with 6-26 leaves. At 46°F/8°C, 10 moles** of light and an 11 hour photoperiod, plants with six leaves initiated flowers in 72 days from seeding. At 68°F/20°C, 2 moles of light and an 8 hour photoperiod, plants initiated flowers in 126 days but had 26 leaves.
- Understanding primula production in terms a 3 life phases (plug, juvenile and reproductive) allows a grower to optimize his/her primula production. Meeting the plant's needs at each stage is the key to success.

* *If the night temperature is above 65°F/18°C some stretching may occur.*

** *1,700 foot candles/18,000 lux for eight hours or 800-1,000 foot candles/8,600-10,750 lux for 14 hours.*



Length of the longest leaf (cm) in *Primula acaulis* 'Danova type'

		<u>Irradiance (mol day¹m²)</u>		
<u>Photoperiod</u>		2	10	18
(hours)				
46°F/8°C	8	1.1	2.9	3.2
	11	2.3	2.6	4.8
	14	2.4	4.4	4.7
54°F/12°C	8	2.6	4.0	3.8
	11	2.9	4.8	3.8
	14	4.5	4.8	3.3

Length of longest leaf (cm) after 8 week of growth from transplant in *Primula acaulis* developing at 46°F/8°C or 54°F/12°C and 8, 11, or 14 hour photoperiod at 2, 10 or 18 mol day¹m² .



Length of the longest leaf (cm) in *Primula acaulis* 'Danova type'

	<u>Photoperiod</u>	<u>Irradiance (mol day¹m²)</u>		
	(hours)	2	10	18
60°F/16°C	8	4.6	5.1	6.3
	11	7.9	8.9	8.3
	14	10.2	9.7	8.5
68°F/20°C	8	4.5	6.0	6.2
	11	4.4	7.6	6.4
	14	4.9	7.8	6.3

Length of longest leaf (cm) after 8 week of growth from transplant in *Primula acaulis* developing at 60°F/16°C or 68°F/20°C and 8, 11, or 14 hour photoperiod at 2, 10 or 18 mol day¹m² .



Length of leaves

- A correlation between long, unsightly leaves to long days or night break has been suggested and therefore avoided. However, temperature appears to be more critical than day length for plant morphology. In polyanthus, more and smaller leaves were recorded at 68°F/20°C than at 50°F/10°C. High fertilizer levels and nitrogen in the ammonium form are also likely factors contributing to larger plants and leaves.



Plant height (cm) in *Primula acaulis* 'Danova type'

		<u>Irradiance (mol day¹m²)</u>		
<u>Photoperiod</u>		2	10	18
<u>(hours)</u>				
46°F/8°C	8	1.2	3.1	3.0
	11	1.7	2.5	4.6
	14	3.0	4.2	4.1
54°F/12°C	8	2.2	3.9	2.9
	11	2.1	3.7	3.4
	14	4.4	3.8	3.3

Plant height (cm) after 8 weeks of growth in *Primula acaulis* developing at 46°F/8°C or 54°F/12°C and 8,11, or 14 hour photoperiod at 2, 10 or 18 mol day¹m²

Research by Dr. Meriam Karlsson, University of Alaska



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Plant height (cm) in *Primula acaulis* 'Danova type'

		<u>Photoperiod</u>	<u>Irradiance (mol day⁻¹m⁻²)</u>		
		(hours)	2	10	18
60°F/16°C	8		4.7	4.6	4.2
	11		4.6	6.0	3.4
	14		5.8	7.8	2.5
68°F/20°C	8		4.8	4.2	5.1
	11		4.6	5.2	5.0
	14		4.3	7.0	5.2

Plant height (cm) after 8 weeks of growth in *Primula acaulis* developing at 60°F/16°C or 68°F/20°C and 8,11, or 14 hour photoperiod at 2, 10 or 18 mol day⁻¹m⁻².



Chemical Plant Growth Regulation

- **Plug Stage:**

Apply B-Nine (daminozide), if needed, at 0.25 - 0.5% / 2,500 – 5,000 ppm

- **Finished Production:**

When plants are well rooted and the leaves are touching the edge of the container assess the plant's development stage.

Options include foliar applications of B-Nine at 0.2 – 0.5% / 2,000-5,000 ppm or Banner Maxx* (propiconazole) at 0.3 ml/L and Bonzi (paclobutrazol) drenches at ½ -1 ppm Usually, 2-3 applications are needed based on plant growth and environmental conditions.

It is best to make frequent applications at lower rates for best control, as a sudden change in the weather can accelerate flower initiation, limiting plant growth potential. Do not base rates on the previous year or anticipate future growth by applying a high rate.

**Banner Maxx is a fungicide with growth regulator effects.*



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Danova flowering guide

- **Early** - Initiate flowers earlier, so avoid over regulation.
- **Medium** - Initiate flowers in the middle so regulate growth accordingly
- **Late** - Initiate flowers later so may require greater regulation.

Early	Medium	Late
Bicolor Apple Blossom Bicolor Rose & White* Blue* Cherry w/Edge Cream Yellow Lemon Yellow* Lime Rose Wine Red	Bicolor Burgundy Bicolor Purple* Bicolor Wine Copper Light Violet Orange Yellow* Pink* Red* Rose Lavender Shades Salmon Orange Scarlet Velvet Red White* Yellow w/Eye*	Bicolor Pink Bicolor Red & Yellow Red & Rose Shades Sky Blue*

***Danova Choice** – is a selection of the best matching colors within the series selected for habit and flowering. Core colors that perform perfectly together.



PGR – Over application



Danova Yellow w/Eye at without growth regulation.



Yellow w/Eye treated with $\frac{1}{2}$ ppm drench of Sumagic and several drenches of Bonzi at 5-6 ppm.



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PGR – Over application



An over application of Bonzi and Sumagic caused an excess regulation of growth and a failure of flower stems to elongate sufficiently.



Danova Cherry w/Edge



PGR – Over application

- Apply growth regulator applications based on the stage of plant development.
- If initiation occurs earlier than normal (due to higher light levels) the plants will be over-regulated.
- Over regulation is more common with extra early flowering varieties.



PGR – Controlling plant habit via culture



Growth regulation is possible by controlling moisture, temperature and fertilizer.



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PGR – Well grown plants with moderate amounts of Bonzi.



Danova Velvet Red



Danova Red w/ Yellow Edge



Danova Yellow

Physiological Disorder - Blindness

Factors that cause blindness

- Short day length
- Insufficient cooling or inconsistent temperatures (cooling followed by warm periods) that confuse the plant.
- Plugs were stressed from a late transplant.
- Excess nitrogen promotes an exaggerated "vegetative" plant response.
- End result is a rosette (resting stage to ensure survival of the species).



Physiological Disorder - Rosette



- The plants exhibit multiple layers of foliage with large leaves.
- If the plants receive sufficient cooling they will set a high amount of buds, (the plant senses that it is the species only chance to survive so it needs to produce many seeds).
- In some cases the plants will never recover.



Physiological Disorder – Bolting



Due to high heat and long day conditions.



Physiological Disorder – Bleaching of upper foliage



Bleaching of upper foliage due to cool soil conditions which inhibits iron uptake. Most often seen in white flowering varieties.



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Pests and diseases

- 1) In general, Primula is not attractive to pests, but aphids, thrips, whiteflies and cut worms are the major concerns.
- 2) Problems with fungus gnat or shore fly are common during the germination and plug stage.
- 3) Primula requires cool conditions and high humidity to produce good quality plants, both of which favor the development of botrytis.
- 4) Good sanitation, watering early in the day and strong air movement all help control and prevent disease.



Pests - Insect biting damage



Leaf damage from cut worm



Set fans for good air flow



Air flow, especially under the trays, aids in preventing diseases and pests.
Avoid placing flats on the ground if possible.



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Raise flats on risers when setting directly on the ground.

- Allowing air movement below flats reduces disease pressure.
- If possible, use risers to raise up flats for better drainage and air movement.



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Disease – Gray Mold (*Botrytis cinerea*)



Botrytis due to excess moisture, poor air movement and dead tissue (possibly from nitrogen deficiency).



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Disease - Gray Mold (*Botrytis cinerea*)



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Disease - Gray Mold (*Botrytis cinerea*)

- Gray mold (*Botrytis cinerea*), on the upper part of the plants and flower petals, usually appears toward the middle to final growing stages due to insufficient ventilation and excess nitrogen fertilization in the early growing stages.
- If you find infected plants, please remove them straight away and increase ventilation.
- The most effective method of preventing this disease is ventilation and temperature control. Gray mold can not spread in conditions of low humidity and temperatures under 54°F/12°C. Also, greenhouse films that block near ultra-violet rays are effective in controlling botrytis.
- Iprodione, Thiophanatemethyl and Polyoxins are effective in controlling Botrytis.



Disease – CMV (*cucumber mosaic virus*)



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Disease – CMV (*cucumber mosaic virus*)

- CMV is a common virus disease and is carried by aphids and through plant contamination (plant touching).
- Primary symptom of CMV is stripes on flower petals and leaves.
- If you find infected plants in fields, please remove the whole plant, including the roots, to prevent the spread of the disease.
- It is required to weed in and around the greenhouse and to use a preventative insecticide spray program.
- DDVP, Nicotine-Sulfate, Benfuracarb are effective in controlling CMV.



Disease - Bacterial soft rot (*Erwinia carotovora*)



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Disease - Bacterial soft rot (*Erwinia carotovora*)

- Caused by high temperature (>76°F/24°C), high humidity and high moisture soil conditions.
- This disease infects the basal part of plant and is characterized by a dark green color rot, resulting in the basal part becoming thinner and finally the wilting of the whole plant.
- This disease can be controlled by soil sterilization with chloropicrin or dazomet prior to planting and by using subirriation to keep the soil surface dry.
- If these fungus disease occurs even once, sterilization of soil, pot, bench and production materials is essential if cultivation of primula is to continue.
- Drenching with Copperoxychloride is effective against bacterial soft rot.



Disease - Leaf spot (*Alternaria* sp.)



Disease - Leaf spot (*Alternaria sp.*)

- Leaf spot (*Alternaria*) appears on the leaves in conditions of high humidity, excess nitrogen fertilization or lack of fertilizer and insufficient ventilation during all stages of primula growth; especially when producing outdoors in open field areas.
- This disease infects the lower and middle leaves of primula due to splashing of mud and produces gray-brown color spots with a deep-brown margin on the surface of the leaf.
- This disease can be controlled by soil sterilization prior to planting and by providing good ventilation.
- It is recommended to use a preventative spray program with a fungicide and apply fertilizer moderately.
- Thiophanatemethyl, Zineb, Polycarbamate, Chlorothalonil and Captan are effective against *Alternaria* leaf spot.



Disease – Leaf spot (*Ramularia primulae*)



A fungus that causes brown and yellow discoloration of leaves.



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Disease – Leaf spot (*Ramularia primulae*)



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Disease – Leaf spot (*Ramularia primulae*)

- *Ramularia* appears on the leaves in conditions of high humidity, over fertilization of nitrogen or lack of fertilizer and insufficient ventilation during all stages of primula growth, especially when producing outdoors in open field areas.
- This disease infects the leaves of primula due to splashing of mud and makes brown color spots with yellow margin on the surface of the leaf.
- This disease can be controlled by soil sterilization prior to planting, by providing good ventilation and applying fertilizer moderately.
- Thiophanatemethyl, Zineb, Polycarbamate, Chlorothalonil and Captan are effective against *Ramularia* leaf spot.



Disease – Bacterial Leaf Spot (*Pseudomonas syringae*)



Pseudomonas is a bacteria that can infect any part of the plant. Usually, weakened, undernourished plants are most affected.



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Disease – Bacterial Leaf Spot (*Pseudomonas syringae*)



Disease – Bacterial Leaf Spot (*Pseudomonas syringae*)

- Soil infection and high humidity conditions produce this disease in Primula, especially in an outdoor fields.
- This disease infects the lower leaves of primula due to splashing of mud at the beginning and spreads over other leaves via overhead irrigation (or rainfall) and makes brown color spot with a yellow margin on the surface of the leaf.
- This disease can be controlled by soil sterilization prior to planting, avoiding cultivating in an outdoor field and by subirrigation to keep soil surface dry.
- Copperoxychloride, Oxine-Copper and Kasugamycin with Copperoxychloride are effective against bacterial leaf spot.



Disease - Bacterial rot (*Pseudomonas marginalis*)



Disease - Bacterial rot (*Pseudomonas marginalis*)

- Soil infection, high humidity and high temperature (over 76°F/24°C) conditions produce this disease in Primula, especially in an outdoor field.
- This disease infects the leaves of Primula due to splashing of mud at the beginning and spreads over other leaves via overhead irrigation (or rainfall) and makes deep brown color rotting with yellow margin on the surface of the leaf.
- This disease can be controlled by soil sterilization prior to planting, avoiding cultivating in an out door field and by irrigating from bottom of pot to keep soil surface dry.
- Copperoxychloride, Oxine-Copper and Kasugamycin with Copperoxychloride are effective against bacterial rot.



Disease – Root rots (*Pythium sp.*, *Phytophthora sp.*)



Pythium and *Phytophthora* due to over watering, poorly drained media or standing water.



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Disease – Root rots (*Pythium sp.*, *Phytophthora sp.*)

- Use pathogen-free seeds, cuttings and plugs.
- Use new or sterilized potting media and pots.
- Use a potting medium with good drainage characteristics to maintain aeration to the roots.
- Grow plants on raised benches when possible to limit splashing spores from the native soil.
- Avoid splashing water between pots or contamination due to runoff.
- Do not apply excessive amounts of water or fertilizer.
- Thrives in oxygen depleted media.
- Do not re-circulate water, if possible, or else sterilize it with UV, sand or copper ionization.
- Etridiazole, Fosetyl-Al, Mefenoxam and Propamocarb are effective against these pathogens.



Disease – Slime Mold (*Physarum gyrosum*)



Disease – Slime Mold (*Physarum gyrosum*)

- It is not a parasite, and will do no injury unless it occurs in immense quantity (when it might be dispersed when spraying the plants with high pressure).
- The early or plasmodium condition develops in darkness, and finally attaches to anything, organic or inorganic, for the purpose of forming its spores in a position where they might be readily dispersed by rain and wind after maturing.



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Danova Sky Blue

