A plant growth regulator which promotes uniform increased budbreak and flowering of kiwifruit, and earlier concentrated flowering of apples.

Active ingredient: Contains 540g/litre hydrogen cyanamide in the form of a soluble concentrate.

INTRODUCTION

Hi-break® has been successfully proven in the field over 18 years of problem-free commercial use.

Independent trials comparing the field performance of **Hi-break**® and **Hi-Cane**®, demonstrated that there is no statistically significant difference between the performance of the two products and orchardists can be confident in the use of either material (see comparative data under TRIALS in this Tech Note).

Hi-break® is a high quality, stable formulation and offers equivalent cost competitive results.

Hi-break® undergoes stringent quality control throughout the manufacturing process. SGS conduct an independent analysis prior to shipment. Upon arrival in New Zealand a further independent analysis is conducted by Flinders Cook laboratory. These high standards for production and handling, ensure that the product performs as indicated.

As part of ongoing product development, Grosafe® is regularly carrying out comparative trials and field assessment studies to ensure **Hi-break**® performs as well as or better than comparative products.

A recent recommendation is the addition of Grosafe's specialty surfactant/buffering agent **Hybrid SB**® to further enhance the efficacy of **Hi-break**®. Data from 2016 independent trial work is included in this Tech Note.

In 2016 Grosafe® developed it's own drift retardant, **Drift Break**®, which when added to the tank mix and applied through air inclusion nozzles, significantly reduces drift.

Grosafe® plans to continue it's R&D with **Hi-break**® to ensure applicator safety, environmental stewardship and enhanced efficacy through the adoption of SCIENCE, TECHNOLOGY and INNOVATION.

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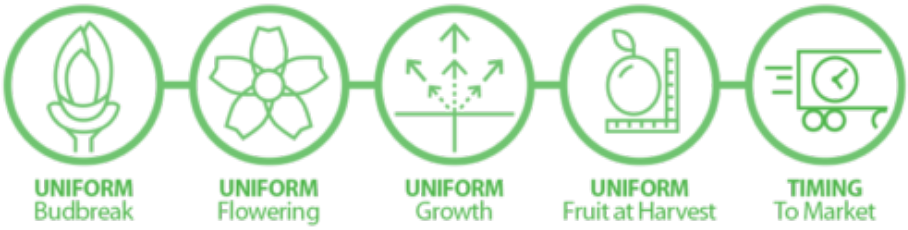
THE SCIENCE OF MANAGING GROWTH

Growth is a complex process. What we see happen in plants is the result of many different, unique chemical reactions taking place within the plant structures. Scientists have discovered what these reactions are, and we have worked to develop products to make plants as efficient as they can be in growing crops.

Hi-break® plant growth regulator is a chemical "dormancy breaking"agent. The change of seasons, specifically cool weather, allows plants to prepare for growth from the buds, once the weather warms. If the chilling hours for a crop are too low, then the plants will not bud, bloom or grow consistently. As a result, crop growth suffers and inconsistent quality can lower the value of the crop.



ABOUT HI-BREAK® - Plant Growth Regulator

Hi-break® is a plant growth regulator used in kiwifruit and apple orchards to break bud dormancy and stimulate more uniform and earlier budbreak. Treatment with **Hi-break**® is necessary in regions with mild winters, where natural chilling is not sufficient to satisfy the chilling requirement of the target crops. The proper application of **Hi-break**® increases the number of emerging buds, which in turn leads to impressive yield increases. Furthermore, **Hi-break**® has proved to considerably advance bloom and harvest time in all kiwifruit and apple growing areas in New Zealand.

The active ingredient of **Hi-break**® is hydrogen cyanamide, a substance which is also present in nature. For example, plants like hairy vetch synthesize cyanamide for self-defence purposes.

Hi-break® is the perfect tool to manage production and harvest time in temperate zone crops. Ongoing research programs support the development of best practices to optimise the growth of crops under ever changing and often challenging conditions.

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STORAGE AND SAFETY INSTRUCTIONS

Hi-break® is temperature sensitive. It should always be stored below 20°C. Higher temperatures reduce the shelf-life significantly. Never let **Hi-break**® stand in the full sun or apply temperatures above 40°C even for short periods. Place in a temperature controlled environment soon after purchase.

Always comply with the safety instructions provided in our safety data sheet. (Available on the Grosafe® website or call Grosafe® for a copy).

EFFECT

A uniform maturity at harvest depends on getting a uniform budbreak. All deciduous fruit crops need a sufficient amount of winter chilling hours to resume normal growth in spring. In regions with mild or without winters, budbreak is not optimal and consequently yield is reduced.

Hi-break® assists by offsetting the lack of chilling hours and ensures an optimal budbreak by releasing the plant from dormancy.

CROPS

The optimal **Hi-break**® application rate and time depends on chilling exposure during dormancy and on other factors like crop variety, growth vigor, stress etc. These factors may vary distinctly depending on the local climatic conditions. Please, follow the instructions on the product label and contact Grosafe® for the best application rate and timing under your conditions.

As **Hi-break**® is a contact chemical, there is no translocation within the plant. Therefore, a thorough covering of the bud with the spray solution is essential. The use of air inclusion nozzles is recommended. Do not apply if rain is expected within 4 hours of application.

As the use of **Hi-break**® may significantly increase crop load, good management (eg, crop thinning, ample water and fertiliser) is essential to optimise export yield in the desirable size counts.

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Kiwifruit

Hi-break® is a plant growth regulator and a management tool that gives kiwifruit growers with mild winters and low Chill Hours accumulation more control in achieving uniformity and in reducing apical dominance. As a consequence of this more uniform and compressed budbreak, bloom and pollination are improved.

Furthermore, less double and treble (downgraded) fruits are commonly in **Hi-break**® treated vines.

Directions for Use on Kiwifruit

General: Hi-break® can cause the following beneficial effects on kiwifruit, particularly useful in orchards which receive inadequate winter chilling:

- An improved uniform budbreak
- An increased number of floral shoots and higher flower numbers, giving a significant yield increase
- A short (4-7 day) flowering period, ideal for spray pollination
- An advanced flowering in one part of the orchard to better fit the management programme (eg, male vines may be treated to supply early pollen for artificial pollination)
- A reduction in the number of doubles and trebles
- **Hi-break**® gives good control of green algae and lichen
- Assists in the control of greedy scale

Rate of Use:
Use 4-6 litres **Hi-break**® per 100 litres of water. Use the highest concentration at the beginning of the application period. A lower concentration within the recommended range may be used as the application period progresses.
To minimise damage, use lower rates after a cold winter or in cooler areas of the orchard (shaded frost pockets). Apply as a fine spray mist to give complete coverage. Spray all dormant buds or effects will be uneven. Ensure the spray reaches in to the central leader and covers the inner canopy. Accurately calibrated airblast sprayers with air inclusion nozzles are recommended.
DO NOT SPRAY TO RUN-OFF AND MINIMISE DRIP POINTS
On mature vines apply 500-700 litres spray volume per hectare. Do not exceed 800 litres spray volume per hectare. The addition of a non-ionic wetting agent is recommended to improve coverage. Grosafe® recommends **Hybrid SB**® as a surfactant/buffering agent plus **Drift Break**® to reduce drift.

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DO NOT APPLY UNDER SLOW DRYING CONDITIONS AS VINE DAMAGE MAY OCCUR (eg, under high humidity; before 9.00am if dew is present or after 4.00pm in shaded parts of the orchard; or during periods when cold frosty nights occur).
Rainfall occurring within four hours of treatment may reduce efficacy.

Timing of Application:
• Var. Hayward. Apply **Hi-break**® in the period between the last week of July and the 24th of August. Applications after this time have more risk of cane damage in a normal year, but may be effective in a very mild winter when budbreak is naturally delayed. The optimum timing is normally the second week of August. Applications towards the beginning of the recommended time period may be less effective, especially in a mild winter and in areas of low winter chilling.
• Var. G3. Experience suggests that the optimum timing is late July/early August. In a very mild winter or in later maturing areas applications during mid August are more effective.

Apples

For young non-bearing trees, use **Hi-break**® plant growth regulator for apical dominance suppression to achieve the desired framework for the trees.

In bearing trees, **Hi-break**® compresses the bloom period to a few days depending upon the weather. Improved budbreak uniformity will also facilitate thinning and promote greater uniformity of fruit maturity at harvest.

General: Hi-break® may be applied to apple trees to obtain the following effects:

• Advanced budbreak and a compressed earlier flowering period. Flowering can be advanced to improve the synchrony of flowering between varieties to achieve better cross pollination. Larger and more uniform fruitlets allow thinning sprays to be timed earlier and more accurately. An earlier flowering reduces the fireblight risk but may increase the risk of frost damage.
• Advanced harvest date, especially in early varieties in warmer regions. Fruit may be ready for harvest 7–10 days early. If temperatures are especially warm at harvest, red colouration may be compromised by an early harvest date.

Directions for Use:
Use 2.5 litres **Hi-break**® per 100 litres of water, in 800-1300 litres of water per hectare, depending on tree size. Apply as a fine spray mist to give complete tree coverage. Treatment should be made 30–45 days before the natural budbreak (50% greentip on spurs) of each variety.

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Applications further out from natural budbreak will have a greater effect on advancing budbreak and flowering, but may reduce the level of budbreak and flowering. Do not apply closer than 25 days before budbreak. Warm temperatures in the three days following application improve the response.

Compatibility: Do not mix with other pesticides. Grosafe® recommends the addition of **Hybrid SB®** surfactant/buffering agent and **Drift Break®** to reduce drift and enhance performance of **Hi-break®**.

Mixing: Add the required amount of **Hi-break®** to the half-filled spray tank. Add the remainder of the water and agitate thoroughly before and during spraying. When using **Hybrid SB®** and **Drift Break®** add the **Hybrid SB®** to the tank first followed by **Hi-break®** and **Drift Break®** last.

BACKGROUND TO CHILL UNITS - Winter Chilling

The growth and development of horticultural crops such as apples and kiwifruit are strongly influenced by weather, including during the winter. While the winter may look like a time of inactivity many things are actually going on with the trees and vines, particularly with regards the development of flowers for the coming season. The coldness of the winter has a very strong influence in most horticultural crops on both the quantity and quality of flowers, as well as the timing of flowering.

Winter chilling is the term used to refer to how effective the cold of winter has been. For instance a year of high winter chilling will generally mean more kiwifruit flowers, an earlier flowering period once Spring temperatures arrive, and often a more compacted flowering period. A number of methods have been developed for measuring the effectiveness of winter chilling. The "chill units" described by each of these methods tries to account in various ways for the way a plant is influenced by winter temperatures. Chilling units are most meaningfully described and measured using an hourly time scale.

Chilling Hours

Hourly temp °C	Base temp 7°C
9°C	0
8°C	0
7°C	0
6°C	1
5°C	2
4°C	3
3°C	4
2°C	5
1°C	6
0°C	0
-1°C	0
-2°C	0

Chilling Hour accumulation below a threshold.

This table shows the number of Chilling Hours accumulated for each hourly temperature reading from a temperature recorder for base temperature of 7°C

Chilling Requirements of Kiwifruit and Apples

Fruit Crop	Approx Hours required under 7°C
Apples	1200 - 1500
Kiwifruit	750 - 850

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Chill Hours Below a Threshold

One of the most common methods for calculating chill units is "Chill Hours". A base temperature is chosen, usually 7°C. If the temperature is above this base then it is too warm for the plant to accumulate chilling. If the temperature is below 7°C then the plant is affected by the cold temperatures, with colder temperatures producing bigger effects. As soon as temperature drops below the base temperature for one hour, one Chill Hour is accumulated. While this system is simple to estimate, it is not very representative of biological processes.

Chilling Hours

A more widely used system is to recognise increasing amounts of chilling as temperatures drop below a threshold and approach zero. If the temperature is 4 degrees below the base temperature for one hour then 4 Chill Hours accumulates and so on. By summing these hourly amounts of chilling over the winter we have a measure of how cold the winter was from the plant's perspective.

This is a simple linear chilling accumulation in which chilling effects are assumed to remain constant at all temperatures below the threshold. In practice, the chilling effect is maximised at the base temperature (7°C is assumed for many crops) and falls away as temperatures experienced by the plant rise or fall beyond the threshold.

This calculation is based on the same concept as Hours Below Threshold, except that it is assumed that the colder the temperatures then the greater the chilling effect. So with a threshold temperature of 7°C, one hour at 6°C is one chill hour; one hour at 5°C is two chill hours etc. One fairly common variation that you may see on both Hours Below Threshold and Chilling Hours is to assume that temperatures below 0°C give no chilling effect.

Chilling Management and Management Responses to Chilling Data

Crop loading and quality can be significantly influenced by winter chilling variability and therefore have profound effects on the commercial performance of the fruit growing operation.

Ideally fruit crops should be grown only in locations where the local climate provides the necessary winter chilling requirements applicable to that crop. The use of available climate data and records will provide a basis for determining geographical suitability of any location for any given crop prior to planting. Local knowledge and experience will be valuable in determining climate suitability.

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In locations where winter chilling may not be adequate, or have not been adequately achieved over any given winter, management tools are available that can artifically simulate the required winter chilling and therefore illicit the sought after flowering response.

Hi-break® can be used to manipulate flowering and vegetative growth commencement and flowering duration.

Summary

- Winter cold has a strong influence in horticultural crops on both the quantity and quality of flowers, as well as timing of flowering.
- Accumulated Chill Hours are used to measure the effectiveness of winter chilling.
- Geographical location selection is important to ensure adequate winter chilling for any given crop.
- Desired winter chilling effects can be simulated with use of **Hi-break**® dormancy season sprays.

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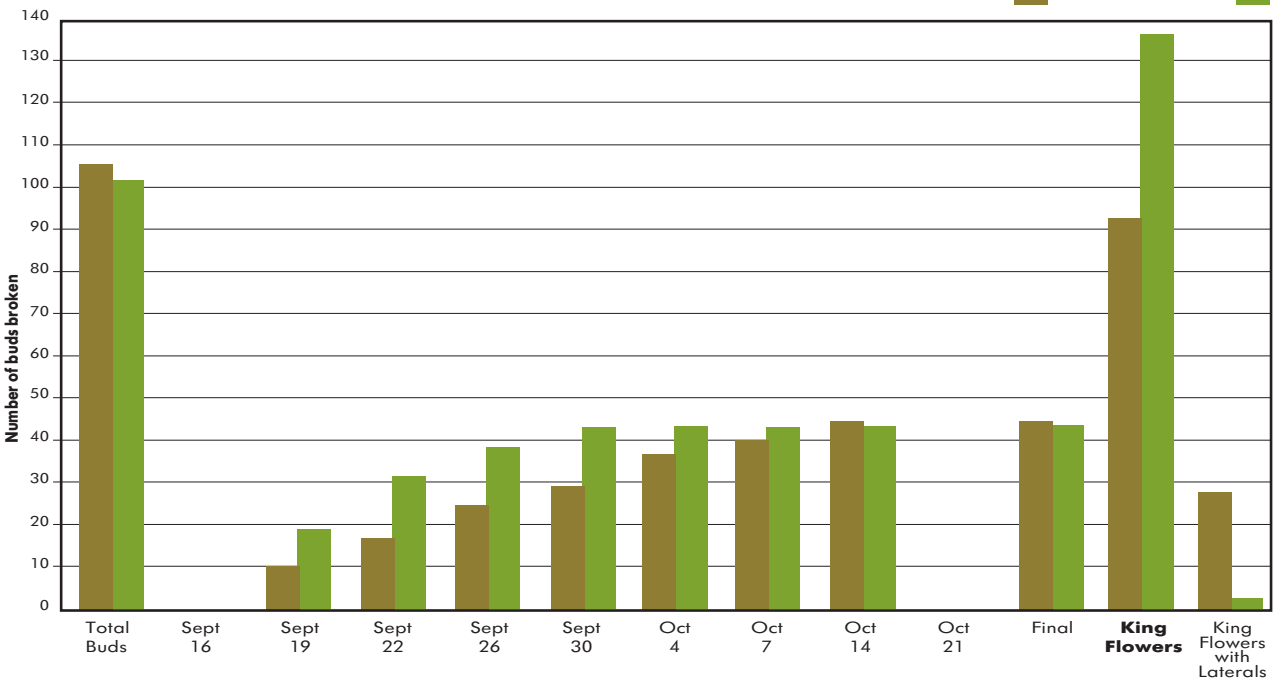
TRIAL RESULTS

Hikurangi Trial - 17/08/16

Treatment A - Hi-Cane® + Driftstop®

Treatment B - Hi-break® + Hybrid SB®

ORCHARD PRODUCTIVITY CENTRE



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TRIAL RESULTS

Comparative Trials -
Conducted by David Sher

Hi-break® v Hi-Cane®

Trial Size

- **Year 1** - 2 orchards, 6 blocks, 96 bays/vines
- **Year 2** - 4 orchards, 8 blocks, 136 bays/vines

Cane Selection for Bud Counts

All dormant, one-year canes, measuring between 9mm and 12mm diameter at the 3rd or 4th wire from the central leader (average distance 1500mm) in each bay from same-numbered rows in each pair of orchard blocks.

Bud Counts

- Taken 21-30 days after budbreak
- All prominent buds counted on each cane
- Burst buds must show leaf development
- Random check on all bud counts

Data Collection

- 232 single-planted vines across 6 orchards
- 1,996 tagged and monitored canes
- 40,038 burst and dormant buds counted

Results
Burst:dormant bud ratio

- Between orchards
  Hi-Cane: 0.97:1 - 2.18:1
  Hi-break:1.01:1 - 2.27:1
- Within orchards
  Hi-Cane 0.97:1 vs Hi-break 1.24:1 (0.27)
  Hi-break 1.20:1 vs Hi-Cane 1.47:1 (0.27)
  Hi-Cane 2.04:1 vs Hi-break 1.99:1 (0.05)
  Hi-break 2.27:1 vs Hi-Cane 2.18:1 (0.09)

Combined Year 1 and Year 2 Budbreak Data

YEAR	ORCHARD	TREATMENT	BURST BUDS	DORMANT BUDS	TOTAL
Yr 1	Riley A	Hi-Cane	1002	724	1726
Yr 1	Riley B	Hi-break	1223	655	1878
Yr 1	Riley C	Hi-Cane	1317	757	2074
Yr 1	Riley D	Hi-break	1033	635	1668
Yr 1	Smith	Hi-Cane	1536	754	2290
Yr 1	Smith	Hi-break	1556	783	2339
Yr 2	Seaview	Hi-Cane	1308	1348	2656
Yr 2	Seaview	Hi-break	2319	1868	4187
Yr 2	Ngai Tukairangi	Hi-Cane	1910	1792	3702
Yr 2	Ngai Tukairangi	Hi-break	1819	1803	3622
Yr 2	Anderson	Hi-Cane	2220	1510	3730
Yr 2	Anderson	Hi-break	2260	1877	4137
Yr 2	SKI OtameMarere	Hi-Cane	1839	844	2683
Yr 2	SKI OtameMarere	Hi-break	2322	1024	3346

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Summary of Treatments

TREATMENT	% BUDBREAK
Hi-break	60.31 (59.18)
Hi-Cane	59.54 (59.02)
approximate s.e.d.	1.53

(s.e.d. = standard error of difference)
% bud break expressed as Back-transformed Means, simple means shown in parenthesis

Statistical analysis compiled by Plant and Food Research

Conclusions

- Only comprehensive hydrogen cyanamide comparative trial
- **No statistically significant difference** between the two products (**Hi-break**® and **Hi-Cane**®)
- Kiwifruit orchardists can be equally confident in the use of either material for budbreak enhancement

RECOMMENDED PRODUCTS - (see Grosafe® tech sheets for details of these products)

Drift Retardants - **Drift Break**®
Water Conditioning Agents - **Hybrid SB**®

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Sample of Certificate of Analysis

SGS

Certificate of Analysis

Report No: SHLSS1202281
Version No: 1.0

		Sample #:	SHLSS1201057RT-1
		Sample Entry Date:	2012-05-15
Product:	Hydrogen Cyanamide	*Batch-No.:*	20120510
Supplier:	N/A	*Packaging mat.:*	In sealed bottle
Quantity:	1bottle		

Test	*Standard*	*Specification*	*Result*	*Complies*
Appearance	Client Method	Sky- blue	Sky- blue	Yes
Cyanamide		25%~55%	52.1%	Yes
Dicyandiamide		NMT 1%	0.4%	Yes
pH		4.5 – 6.5	4.6	Yes
Stabilizer		NMT 1.5%	0.7%	Yes
Thiourea		NMT 0.2%	0.04%	Yes

Evaluation :

All results meet the requirements
No OOS occurred.

approved by:

Signature/Date
- QA -

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