

HOMOBRASSINOLIDE: Crop Productivity and Quality

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Auxins	Gibberellins
Cytokinins	Ethylene
Abscisic Acid	Brassino- steroids



Brassinosteroids

What are they?

- A New Generation Plant Growth Regulators (PGRs)
- Naturally Occurring Substances
- Have Significant Plant Growth Promoting Activity
- Trade Names for Homobrassinolide: HBR, Homobrassin, and Initiator Homobrassin

What do they do?

- Improve physiological and biochemical processes of crop growth and development
- Promote cell elongation and cell division, seed germination and photosynthesis and selected enzymes
- Provide greater plant stress tolerance, flowering, fruit growth, and overall quality of the crops

Characteristics

- Fully biodegradable
- Leave behind no residues
- Environmentally safe and friendly

Supporting Factors

- Homobrassinolide, which is a type of brassinosteroid, is compatible with many commonly used PGR factors such as:
 - Pesticides
 - Fertilizers
 - Micronutrients



Chemical Structures for Brassinosteroids

Out of the 70 known variants of Brassinosteroids, the following three presented are the most active:



BRASSINOLIDE (I)



EPIBRASSINOLIDE (II)



HOMOBRASSINOLIDE <u>(HBR)</u> (III)



Mode of Action and Crop Benefits

- Brassinosteroids (including homobrassinolide) have a nontoxic mode of action.
 - Brassinosteroids increase the efficiency of plant growth and development in addition to maintaining the plants health.
- Brassinosteroids contribute to increasing the crop yield and crop efficiency.



HBR Application Rates & Crop Uses

Crops	Species	Application Rate (Fl. Oz. / Acre)
Fruit and Nut Crops	Citrus	26.6
	Oil Seed	13.3-26.6
	Pome	13.3
	Grapes and Berries	6.6-26.6
	Stone Fruit	13.3-66.0
Grain Crops	Cereals	13.3-26.6 per application
	Non-Grass Feeds	13.3 per application
Vegetable Crops	Leafy Vegetables	13.3 per application
	Bulbs	13.3-26.6
	Legume	13.3
	Root & Tuber	3.3-26.6
	Cucurbit	13.3 per application
Other Crops	Cotton	1.6 per application
	Flowering Plants	1.6 - 3.3
	Hops & Leafy Greens	13.3-26.6
	Теа	13.3 per application



COMMERCIALIZATION OF HOMOBRASSINOLIDE

- In order to commercialize Homobrassinolide, Repar
 Corporation (Repar) applied for the registration of HBR with
 U.S. Environmental Protection Agency (EPA).
- The EPA granted the registration for HBR technical in 2010 by providing the product chemistry data (manufacturing process, five batch analysis and physical and chemical properties) and also health and safety data.
- The EPA also granted tolerance exemption for HBR.
 Therefore, the residues in HBR are not a concern and HBR can be used on all crops.



COMMERCIALIZATION OF HOMOBRASSINOLIDE (Cont.)

- Repar has obtained the registration for HBR 1.0%, so that it will be used as a manufacturing-use product (MP) for reformulation into several end-use products (Eps) for direct application to crop plants.
- Repar has also obtained the registration for HBR 0.1% in May 2016. This product is now used for application to all crop plants.
- Repar started marketing HBR in 2017 on fruit and nut crops in Pacific Northwest. HBR will be marketed in the coming years (after 2018) on other crops listed on the product label.



Economic Benefits of HBR applications

Good ROI via Improved Yields and Quality

- Greater fruit number, size and or sugar content (BRIX)
- Increased crop yields resulting from improved crop health
- Faster seed emergence results in more time to grow
- Increased cotton yield & fiber length

Good ROI by Timing of Harvest

- •Time delivery of ripe fruit to market
- •Synchronize ripeness of fruits
- Reduce harvest trips
- •Manage risk by harvesting before weather events
- •Time harvests to manage labor availability



Evaluation of HBR on Fruit and Nut Crops

HBR 0.1% was evaluated over the last five years on several fruit and nut crops in the U.S. and Chile including:

- Grapes (table and wine varieties)
- Strawberries
- Blueberries
- Cherries
- Apples
- Pears
- ✤ Walnuts
- ✤ Almonds

In 2016, HBR was evaluated in Washington and Oregon on a large scale by testing HBR on 1-5 acre lots (cherries, apples and pears).

In 2017, HBR is being evaluated on cherries, apples, pears, blueberries, potatoes, onions, cucumbers, and hops, among others in PNW.

In 2017, HBR field trials are on-going in Great Lakes area on cherries (sweet and tart cherries) at three locations (1-2 acre lots).



Summary of HBR Evaluation

HBR was found to work actively on all of the crops previously listed, effectively increasing crop yield, fruit size, fruit firmness, early maturity (fruit ripening) and overall quality of the fruit which includes increased sugar content.

HBR was also found to be active in tree nut crops such as almonds and walnuts by increasing the fruit set and nut size and achieving early maturity of the crop.



HBR Field Trials



Cherry Trials

Two cherry trials were conducted in 2016 with the new HBR 0.1% formulation in Hood River, OR & Dallesport, WA





Comparison of Treatments (In Field)



HBR Treatment

Untreated



Evaluation of Cherry Trials

Findings:

- In all cherry trials, results show that HBR is effective on cherries at the lower label rate of 13.3 fl. Oz. / acre.
- Rain did not show any adverse effects on the crops (e.g. pitting).
- HBR-treated cherries may be harvested up to one week earlier than the cherries treated with Grower Standard (GIB).

Summary of Results:

- Overall, HBR 0.1% was found to:
- Deepen the color of cherries
- Increase soluble solids (sugar content)
- Lead to earlier maturity of the fruit
- Increase fruit firmness
- Increase stem removal force



Grape Trials

A grape trial was conducted in 2016 with the new HBR 0.1% formulation in a wellestablished commercial grape vineyard located near Fresno, CA.

This study was conducted to evaluate the effects of Homobrassinolide (HBR) on Scarlet Royal variety (table) grapes to enhance ripening.	Specifically, HBR in this trial was evaluated for effects on increasing soluble solids, enhancing cluster color, and berry hue.
Ripening is important in grapes to enhance quality or advance maturity without break down.	After berry softening, berries grow to maximum size and soluble solids increase at rates of about 1 to 1.5 degrees Brix per week until fully mature.
Maximum yields are met when soluble solids are highest without loss of water to increase Brix levels in the fruit.	Normally soluble solids reach 20 to 22 Brix, or higher by harvest.



Effects of HBR on Grapes to Enhance Fruit Size



Control (Grapes appear darker due to shadows)

HBR Treatment



HBR Evaluation on Grapes

Similarly, Repar has been evaluating HBR on grapes over the last 5 years at different locations in CA and OR and also in Santiago, Chile on different table grapes. Repar also evaluated HBR on wine grapes.

Working on Grapes at Label Rates:

 In 2016, Repar conducted 4 trials on grapes (table and wine) using the HBR label rates in California.

Results:

- All of the results show that HBR is effective on grapes at the lower rate of 13.3 fl. oz. per acre.
- Overall, HBR 0.1% consistently resulted in:
 - Improved yield
 - Fruit firmness
 - Improved color
 - And early maturity among others



EVALUATION OF HBR ON BLUEBERRIES (HICKS, 2012):

This field trial was conducted in Fresno, California to assess the effectiveness of HBR for enhancing blueberry fruit quality.

Results:

- Similar to other trials, fruit firmness as compared to control is increased in the first picking by HBR application.
- Soluble solids content as compared to control are seen to increase from treatments of HBR.
- Crop yield and size of the berry as compared to the control are also seen to increase from treatments of HBR.



Effects Of HBR 0.1% On Crop Yield (Almonds)





Untreated

HBR Treatment

HBR applications rates of 10ppm showed statistically significant differences between treatments related to both weight and kernel width with no observed phytotoxicity:

- Weight by 30%
- Kernel width up to 40%
- Kernel density at ~20%



APPLICATION RATES OF HOMOBRASSINOLIDE FOR TARGETED CROPS

Crop	Growth Stage	Dose [g (a.i.) / acre]
Wheat	Tillering, spike initiation Tillering Flowering	1.250-2.500 0.020-1.050 0.0125
Barley	Tillering	0.125
Oats	Tillering	0.050
Rice	Tillering, panicle initiation Panicle initiation, flowering	0.625-2.500 0.250-0.750
Corn	4-5 leaf stage; tasselling	0.125
Peanut	Flowering and pegging Flowering, pegging and pod initiation	0.625-1.250 0.625
Soybean	Flowering	0.125
Mustard	30 and 45 days after sowing	0.625-1.250
Potato	Budding 7-10 days after tuber initiation and at tuber bulking	0.050 0.625-2.500
	25 and 35 days after seedling emergence	0.625-1.250
Sugarbeet	12 leaf stage	2.500
Cotton	30, 50, and 70 days after sowing	0.250-2.500



General Benefits of HBR

General Benefits

- Increased crop yield (from 10-20%).
- Increased overall sweetness of fruit (resulted in increased sugar content, BRIX, of fruit crops)
- Increased fruit quantity and quality
- Early maturity
- Fruit firmness (durability)

Applicability/Versatility/Usefulness of HBR

Can HBR be used on all crops?

- Yes, HBR can be used on all food and feed crops because it is tolerance exempt, meaning the residues of HBR-treated crops are of no concern.
- Repar is planning to obtain MRL exemption for HBR-treated commodities, so that the HBR-related commodities can be exported to all OECD countries. This is beneficial to growers of all fruit and nut crops as well as other commodities too.

What is the amount of HBR needed per acre?

- The amount of HBR required per acre is 13.3 fl. oz.
- A gallon of 0.1% HBR would cover up to **<u>20 acres</u>** with a single application.





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