



Agriculture and
Agri-Food Canada

Agriculture et
Agroalimentaire Canada



Development of a Branch Shaker to Harvest Seabuckthorn

Roger Chagnon, Eng., Jérôme Boutin, Eng. and Sylvain Fortin, Eng.

Agriculture and Agri-Food Canada,
Horticulture Research and Development Centre,
Saint-Jean-sur-Richelieu, Québec, Canada

Canada 

Development of a Branch Shaker to Harvest Seabuckthorn

Prototype we developed at the end of this project:



Development of a Branch Shaker to Harvest Seabuckthorn

Introduction:

Branch shaker made from modified reciprocating saw:

- Thanks to Dr Thomas Li for these pictures
- Simple and not costly
- Works fast but need to optimize performances
- Operator's hands shake as much as branches
- Need to reduce operator fatigue and risks of injuries



Development of a Branch Shaker to Harvest Seabuckthorn

Our objectives for this project:

- 1- To determine proper parameters for a seabuckthorn branch shaker
- 2- Develop and test a suitable prototype



Development of a Branch Shaker to Harvest Seabuckthorn

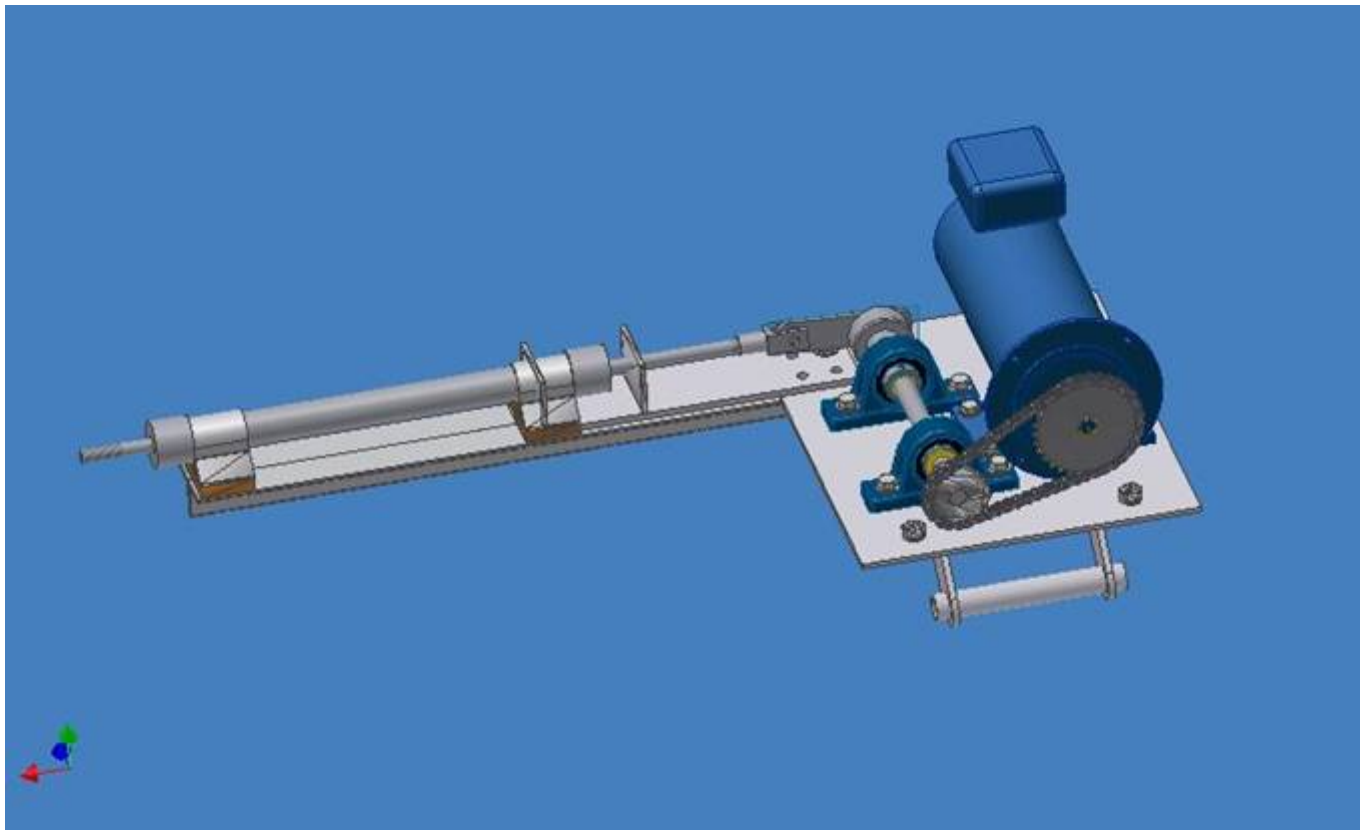
Our project:

- Began in 2003 and ended in 2005
- Three prototypes were developed, one every year.
- Tests done in seabuckthorn orchards in Québec.
- Performances were measured for the two first ones.
- Damages to the branches were assessed.
- Proper parameters for a seabuckthorn branch shaker were determined

Development of a Branch Shaker to Harvest Seabuckthorn

Prototype in 2003:

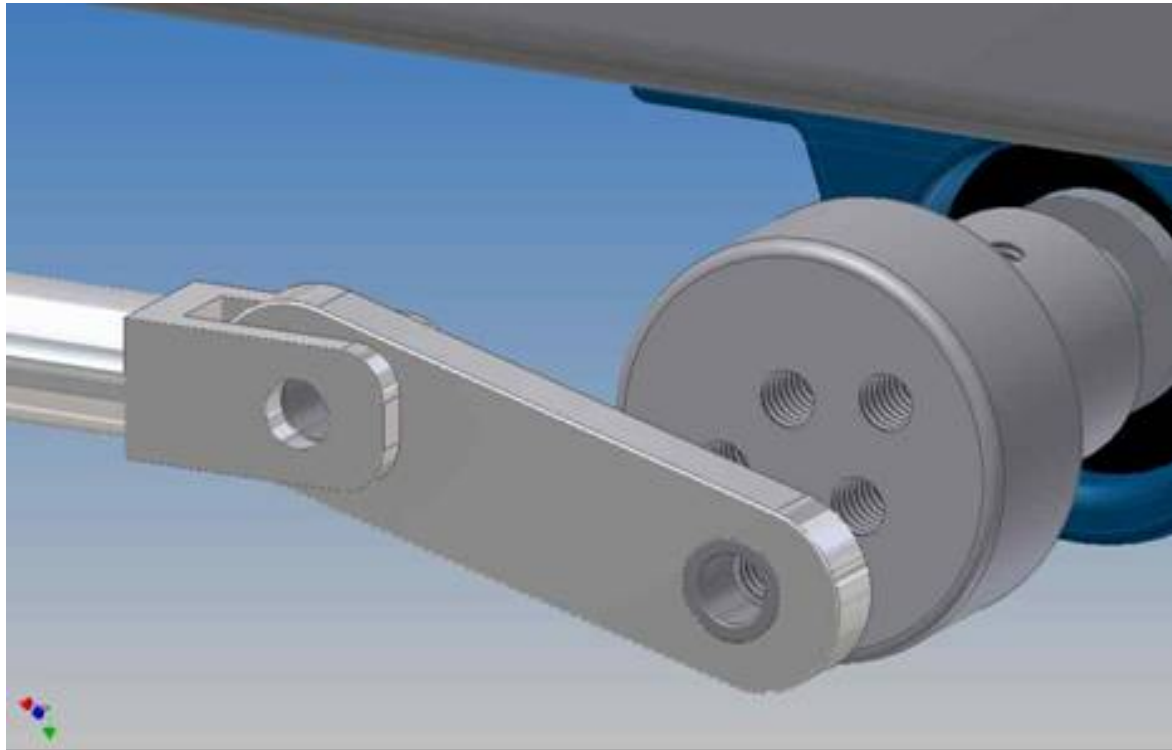
- Powered by a 0.75 kW 110 V electric motor to enable easy changes in frequency from 10 to 50 Hz (600 to 3000 RPM)



Development of a Branch Shaker to Harvest Seabuckthorn

Prototype in 2003:

- A crank-shaft assembly enables easy changes for the amplitude from 15 to 35 mm by simply moving a bolt.



Development of a Branch Shaker to Harvest Seabuckthorn

Testing of 2003 prototype:

- Suspended from a winch to an arm attached to the back of a Gator to perform tests on trees.



Development of a Branch Shaker to Harvest Seabuckthorn

Testing of 2003 prototype:

Variables tested:

- Frequencies: 10, 20, 30, 40, 50 Hz
- Amplitudes: 15, 20, 25, 30, 35 mm
- Durations: 5, 15, 30 sec.
- Every combination repeated tree times
- in two orchards: Mr André Nicole and CDBQ.

Development of a Branch Shaker to Harvest Seabuckthorn

Testing of 2003 prototype:

- A bag was placed over the branch before shaking
- After shaking, berries and debris were emptied in sample bag
- Branch was cut and kept in large bag for later counting of berries left on the branch.
- Another branch was shaken same way without a bag and left on the tree for damage evaluation next year.



Development of a Branch Shaker to Harvest Seabuckthorn

Testing of 2003 prototype:

- Typical result: material harvested after 5, 15 and 30 sec. at 30 Hz and 15 mm.
- Most berries harvested within 5 sec., some more if shaken 10 more seconds and mostly leaves and debris in the last 15 seconds.



Development of a Branch Shaker to Harvest Seabuckthorn

Results of 2003 prototype:

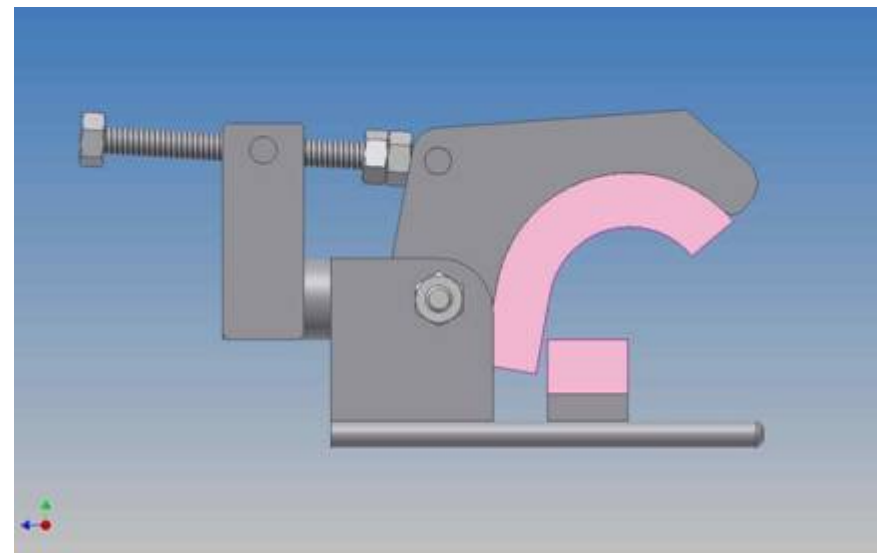
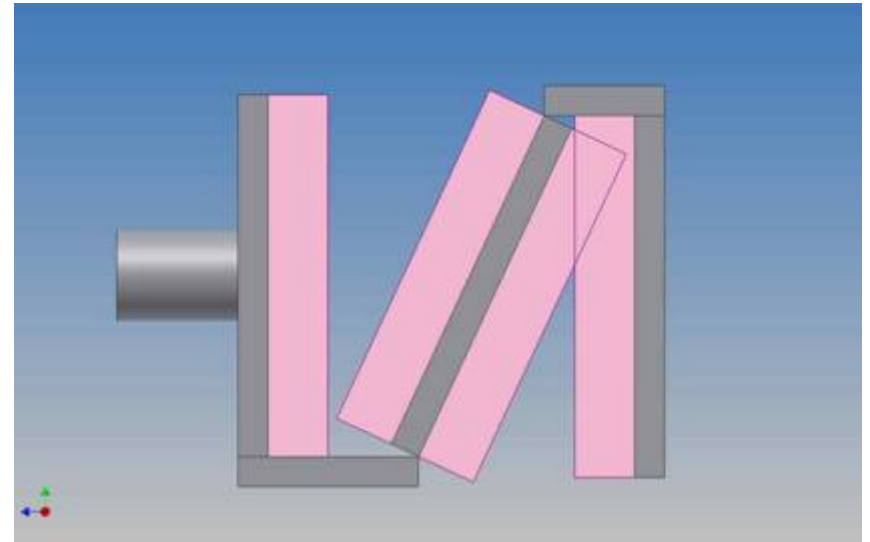
- 10 and 20 Hz were not effective enough even after 30 sec.
- 30 Hz gave good results for every amplitude; duration of 15 sec was enough
- 40 and 50 Hz gave good results with 5 sec duration and 15 and 20 mm amplitude but many leaves were detached from branches. Not enough power to test longer amplitudes.
- These tests were performed late in September and October, too late for optimal maturity.

Development of a Branch Shaker to Harvest Seabuckthorn

Testing of 2003 prototype:

Two claws were tested to hold the branches:

- an open one
- a closed one.



Development of a Branch Shaker to Harvest Seabuckthorn

Testing of 2003 prototype:

- Branches were identified and painted in green each side of the claw to facilitate damage evaluation.
- The open claw was easy to position but moved during shaking and caused too much injuries to the branches.
- The closed claw caused less injuries but was slow to position; improvements were needed.



Development of a Branch Shaker to Harvest Seabuckthorn

Prototype in 2004:

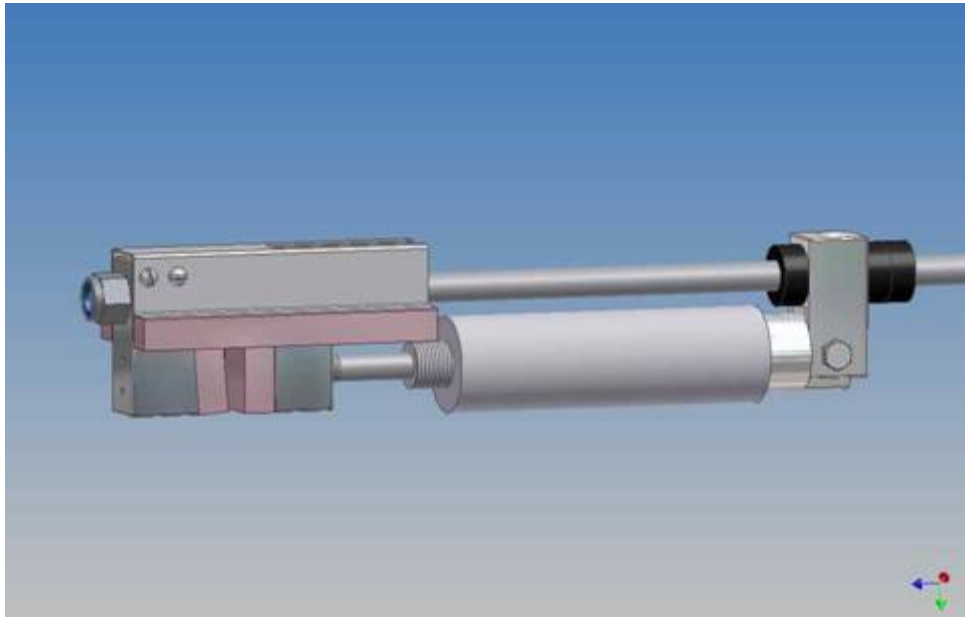
- Components almost identical to the 2003 prototype except:
- Bigger electric motor with 1.5 kW instead of 0.75 kW
- Total weight was 71 kg
- New claw was developed



Development of a Branch Shaker to Harvest Seabuckthorn

Prototype in 2004:

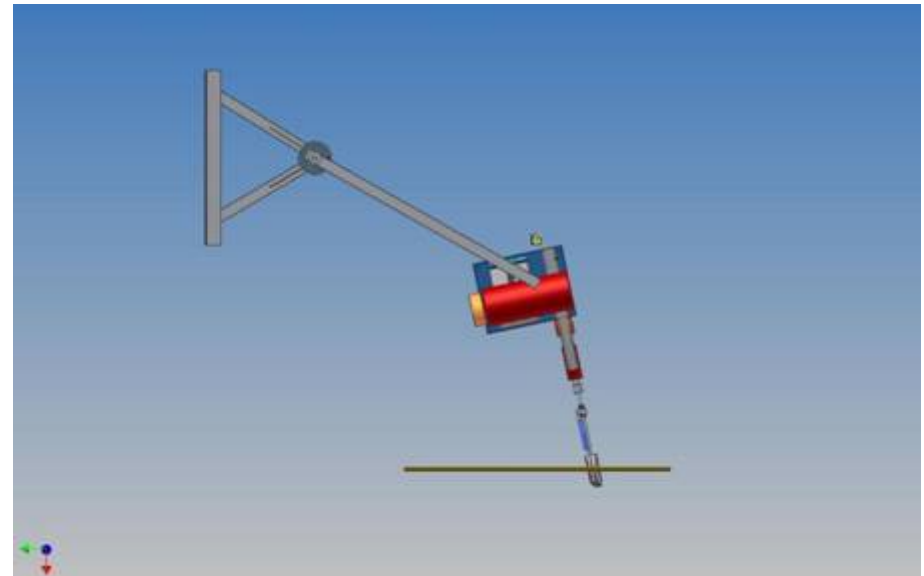
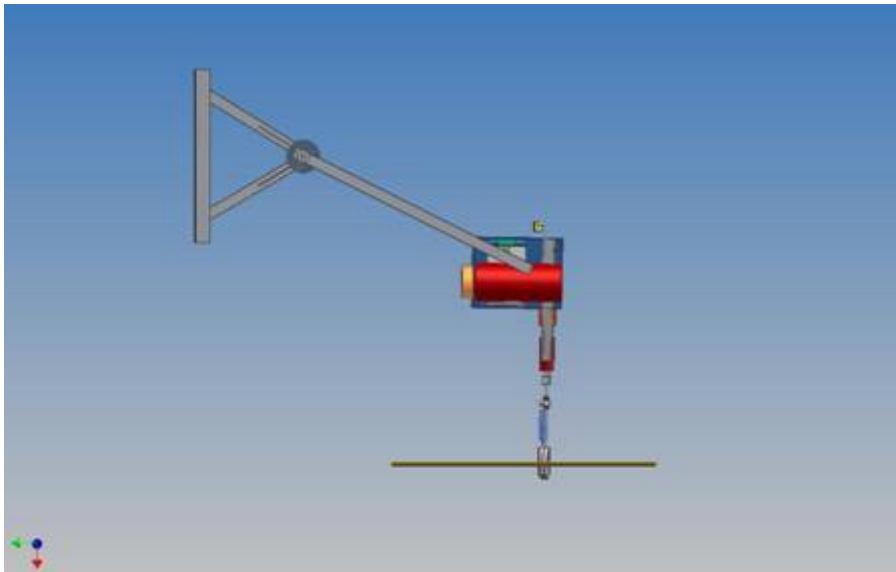
- The new claw is opened and closed by an air powered cylinder; a source of compressed air is needed.
- Fast and easy to position and caused low damages to branches.



Development of a Branch Shaker to Harvest Seabuckthorn

Position of branch shaker:

Important to position shaker square to branch before shaking to avoid damages to bark (top view):



Development of a Branch Shaker to Harvest Seabuckthorn

Testing of 2004 prototype:

- Prototype suspended from a winch to an arm attached to the back of a Gator with small electric generator and air compressor.
- Tests done from August 9 to September 3, on four years old « Indian Summer » trees.



Development of a Branch Shaker to Harvest Seabuckthorn

Testing of 2004 prototype:

Variables tested:

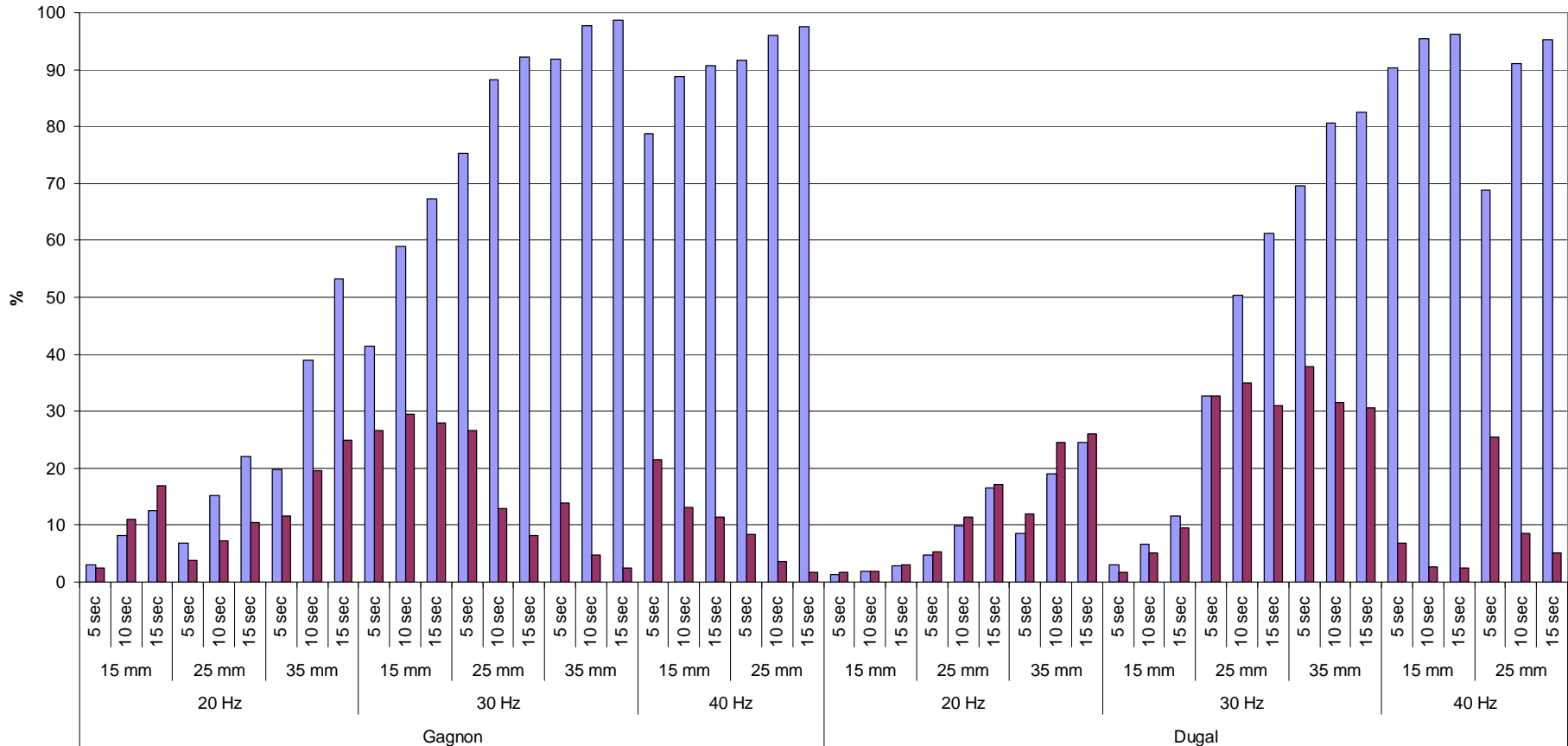
- Frequencies: 20, 30, 40 Hz
- Amplitudes: 15, 25, 35 mm*
- Shaking duration: 5, 10, 15 sec.
- Every combination repeated five times
- Same tests repeated in two orchards:
Mr Pierre Gagnon and François Dugal.

*(35 mm not tested for 40 Hz)



Development of a Branch Shaker to Harvest Seabuckthorn

Results of 2004 prototype: Harvesting efficacy

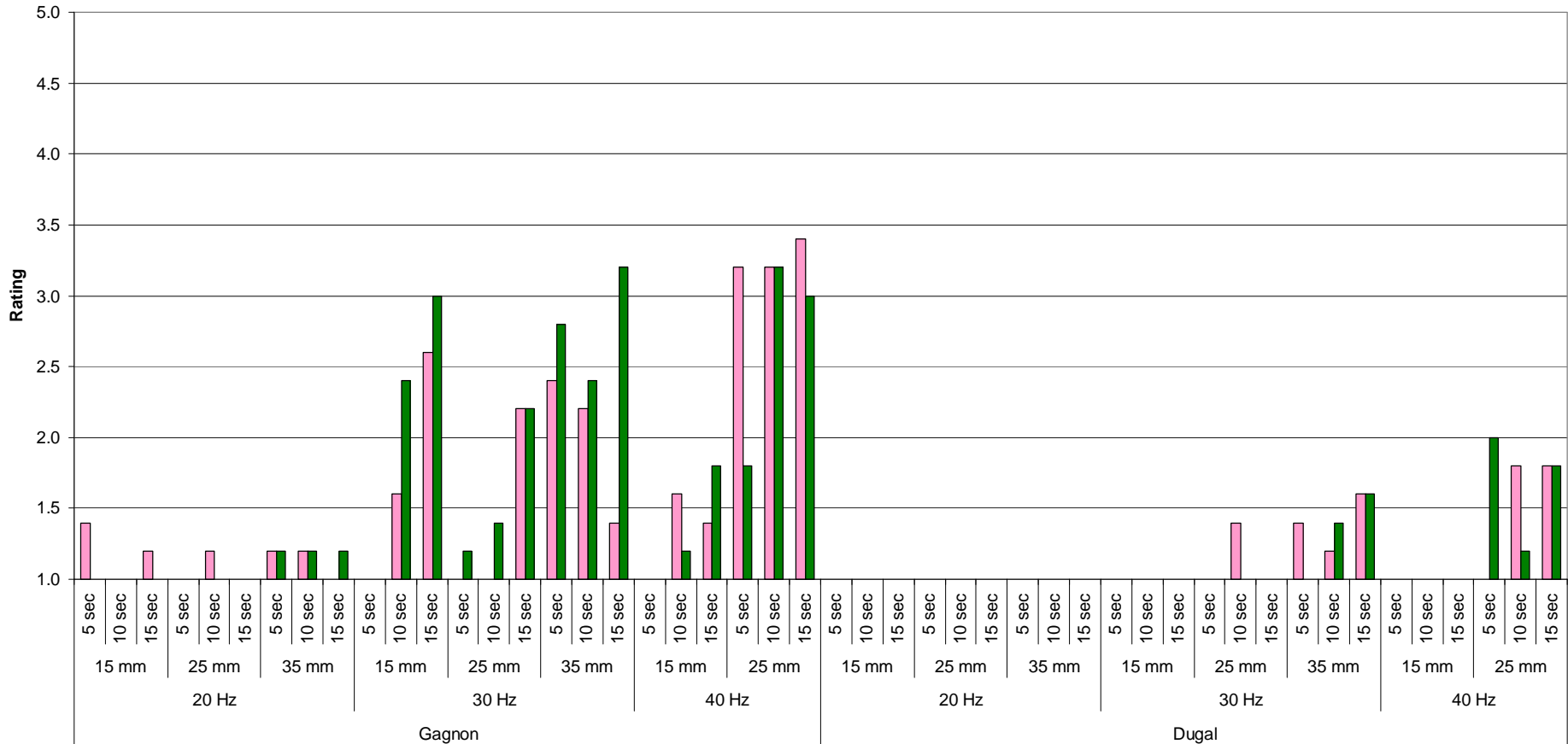


Berry harvesting efficacy at two sites: Gagnon and Dugal

■ Mean of the harvesting efficacy ■ Standard deviation of the harvesting efficacy

Development of a Branch Shaker to Harvest Seabuckthorn

Results of 2004 prototype: Damage to branches

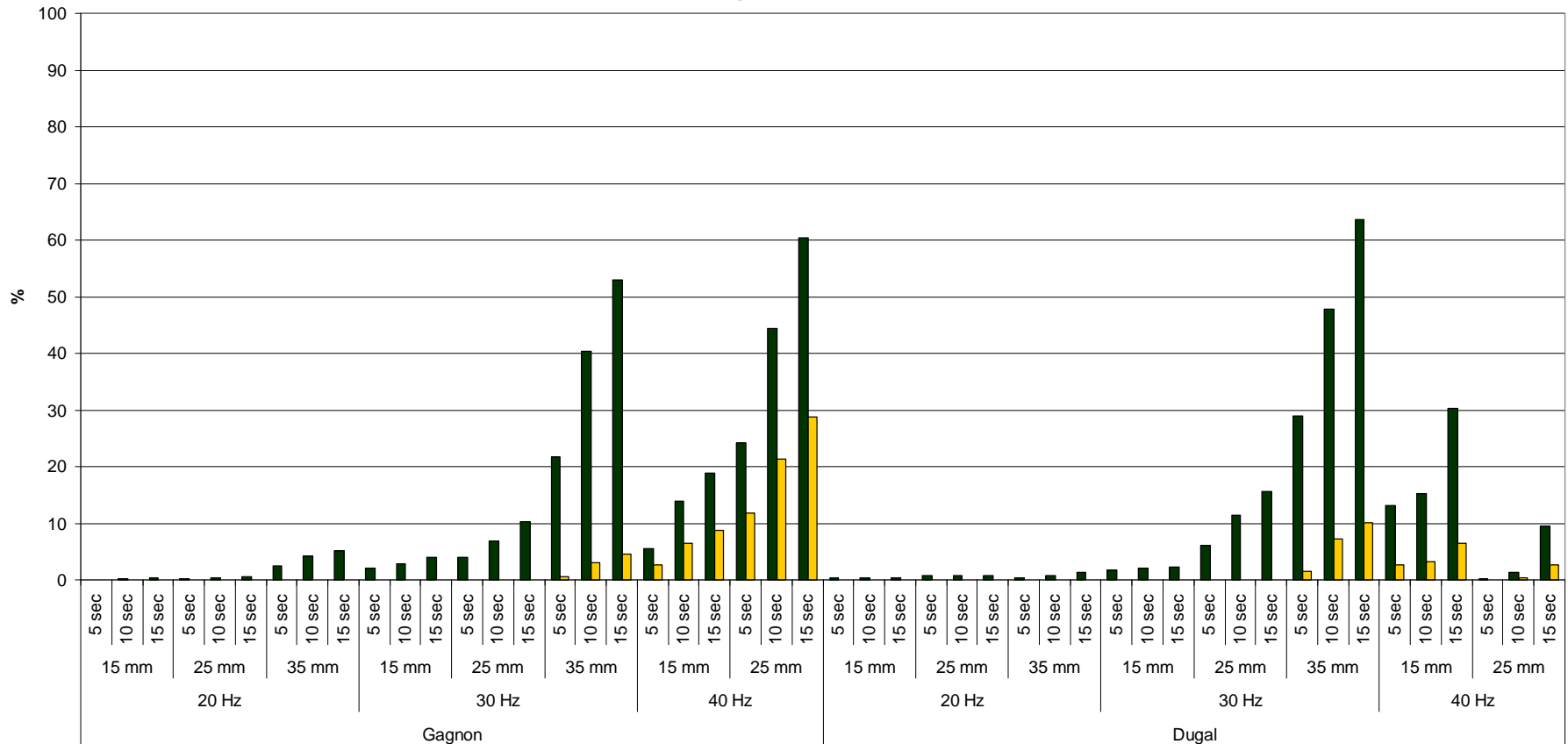


Damage to branches shaken: claw level and hole branch (1 = none, 5 = high) at two sites

Mean of the damage rating done by the claw Mean of the damage rating done to the branch

Development of a Branch Shaker to Harvest Seabuckthorn

Results of 2004 prototype: Debris harvested



Amount of debris harvested in % (leaves and wood) at two sites

■ Mean of the percentage of leaves harvested ■ Mean of the percentage of wood harvested

Development of a Branch Shaker to Harvest Seabuckthorn

Results for parameters in 2004:

- 20 Hz was not effective.
- Harvesting efficacy over 90% was obtained at 30 Hz with 25 and 35 mm and at 40 Hz with 15 and 25 mm; duration of 10 seconds was enough most of time
- Damages and amount of debris increased with time of shaking and were maximum with 30 Hz 35 mm and 40 Hz 25 mm.

Development of a Branch Shaker to Harvest Seabuckthorn

Recommended parameters:

- Best parameters were: 40 Hz, 15 mm, 10 seconds.
- A second choice would be: 30 Hz, 25 mm, 15 seconds.

Development of a Branch Shaker to Harvest Seabuckthorn

Prototype in 2005:

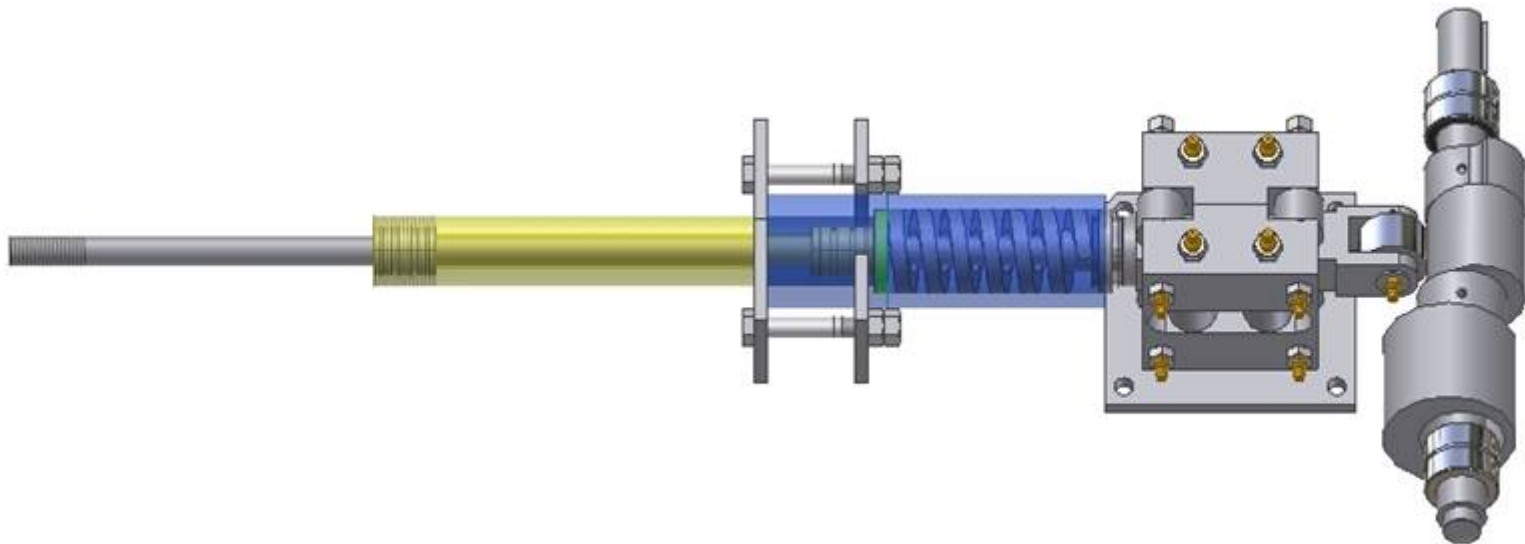
- Developed to be as close as possible from a commercial unit and to be operated with a farm tractor.
- Powered by a hydraulic motor. Safer to use than electric motor and cables
- Total weight is 68 kg



Development of a Branch Shaker to Harvest Seabuckthorn

Prototype in 2005:

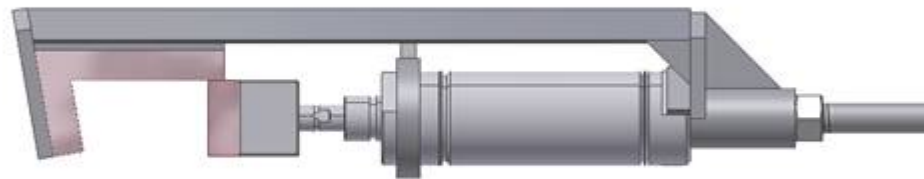
- Use of a cam instead of a crank-shaft to produce the back and forth shaking action. As the shaft rotates, the cam pushes the arm outwards and a strong spring brings the arm back. Amplitude is fixed at 15 mm
- Designed to operate at high frequency of 40 Hz; the cam operation was balanced by providing counterweight on the same shaft.



Development of a Branch Shaker to Harvest Seabuckthorn

Prototype in 2005:

- A new air operated claw was developed
- Same principle but simpler and lighter design
- No formal testing in orchards in 2005.



Development of a Branch Shaker to Harvest Seabuckthorn

Prototype in 2005:

- Three point hitch attachment developed
- Tests in workshop showed the system was operating fine but not tested in orchards; large tractor needed.



Development of a Branch Shaker to Harvest Seabuckthorn

Prototype in 2005:

Prototype used at two farm sites: Mr Pierre Gagnon and André Nicole.

Some comments from users:

- No large tractor, nor space between rows, could not use three point hitch
- Too slow to move from one branch to another
- Difficult to move and position
- Two persons needed
- Not practical for whole orchard harvesting
- Berry recovery not solved
- System not finalized

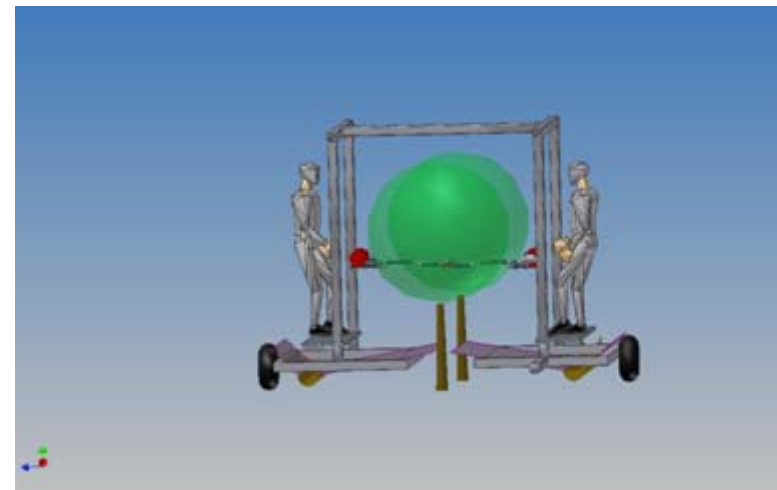


Development of a Branch Shaker to Harvest Seabuckthorn

Concept for using this prototype:

Our scenario for future was:

- Develop a frame to hold branch shakers each side of the trees.
- Use a farm tractor to pull frame and power shakers.
- Sloped floor would gather berries falling from trees.
- Larger farm would use longer frame with more shakers.



Development of a Branch Shaker to Harvest Seabuckthorn

Conclusions:

- Three prototypes were developed from 2003 to 2005.
- Harvesting performances and damages to the branches were measured for the two first ones.
- Best parameters identified were:
 - Frequency: 40 Hz
 - Amplitude: 15 mm
 - Vibration time: 10 seconds
- Prototype not commercially available.
- More R&D needed for this to become an interesting option.

Development of a Branch Shaker to Harvest Seabuckthorn

Thanks a lot to those who contributed to this project:

- Thanks to growers and organizations who contributed to this project by accepting and helping our team to perform tests in their seabuckthorn orchards:
 - Mr André Nicole, Pierre Gagnon, François Dugal and Léo Boutin.
 - Centre de développement bioalimentaire du Québec (CDBQ)
 - Institut de Recherche et de Développement en Agroenvironnement (IRDA) at Deschambault.
- Thanks to Mr Romain Rioux from CDBQ who helped in assessing damages to trees.
- This project was funded by Agriculture and Agri-Food Canada



Agriculture and
Agri-Food Canada

Agriculture et
Agroalimentaire Canada



Thank you ! Questions?

For more information: chagnonr@agr.gc.ca

AAFC web site: www.agr.gc.ca

HRDC web site: www.agr.gc.ca/science/stjean

Canada 