Hāpi String Trials

Trialling sustainable string options

Report Section Prepared by David Dunbar and Sean Riley of Freestyle Hops Ltd and MJ Stephens of Select Breeding Solutions Limited in August 2021.

Introduction

Prior to 2020, the New Zealand hop industry predominantly used polypropylene string for supporting hops. Poly string has multiple drawbacks as a support structure for hops. It doesn't compost with the rest of the bine, which is eventually returned to the hop garden and its slick/thin form can cause the mature bines to easily slide down the structure.

Other commercial string types that are compostable include coconut coir which is used extensively in the USA and Australia and cornstarch-based (PLA biopolymer) string. Coconut coir string is readily compostable in a typical on-farm windrow composting process. Cornstarch based polymer string, such as "Bio-Hop" is compostable in an industrial (high heat) composting process, however, does not typically breakdown in a standard on-farm process. Operational and growth/yield questions were examined as well as string failure rates. String failure is a particularly acute problem for New Zealand growers looking for poly alternatives due to the unique combination of high UV levels and high rainfall relative to other global growing regions.

When considering string types, multiple questions were examined, including the following:

1. What are the acquisition costs?
2. What are the installation costs?
3. How do installation labour requirements vary?
4. Does the string type effect hop training costs or labour requirements?
5. What are the string failure rates?
6. Does string type effect yield?
7. How does string type and stringing method effect harvest?
8. How does string type effect hop processing?
9. How does string type and stringing method effect post-harvest activities?
10. How does string type effect composting and other sustainability initiatives?

String Trial Results

String Trial (Growth and Yield)

We found meaningful differences between the string type used for the number of nodes, estimated number of laterals, numbers of cones per lateral and estimated total cone numbers and yield with coir string outperforming the alternatives. Estimated cone yield was higher for coir than poly and bio twine for Nelson and Motueka varieties (Table 1). Further, coir trained plants reached the top wire slightly later on average than those on poly. It is important to note that while these differences were statistically significant, they were small absolute quantities of improvement. For interest, Table 2 shows the differences between the cultivars for traits measured. It is interesting to note Nelson Sauvin's ability to develop high numbers of cones per lateral compared to Motueka.

Table 1

Effect of string type on plant yield components and date reached top wire for string trial at Freestyle hops

	Coir	Polypropylene	"Bio Hop" Twine
Number of Bines	6 a[y]	6 a	6 a
Number of Nodes	20 a	20 a	18 b
Avg. Date at Top Wire	22Dec a	19 Dec b	18 Dec a
Avg. Bine Diameter (mm)	7.8 a	8 a	8 a
Calc. Est. Total No. of Laterals	119 a	116 a	111 b
Avg. Cone No. per Lateral	61.4 a	54.3 b	57.1 b
Calc. Est. Cone No. per Plant	7435 a	6449 b	6327 b
Est Yield[z] (kg/plant)	2.3 a	2.1 b	2.1 b

[z]Dried hops

[y]Different letters in a line indicate significant differences according to the standard error of the mean

Table 2

Effect of string type for each varietal on plant yield components and date reached top wire for string trial at Freestyle hops.

String	Varietal	Number of bines	Number of Nodes	Date at Top Wire	Est. yield[z] (kg/plant)
Coir	Nelson	6 a[y]	20 a	22 Dec a	2.8 a
Poly	Nelson	6 a	20 a	19 Dec a	2.3 b
Bio twine	Nelson	6 a	19 a	18 Dec b	2.5 c
Coir	Motueka	6 a	19 a	19 Dec a	1.7 a
Poly	Motueka	6 b	20 b	19 Dec a	1.4 b
Bio twine	Motueka	6 a	18 c	16 Dec b	1.4 a

[z]Dried hops

[y]Different letters in a line indicate significant differences according to the standard error of the mean

String Trial - Installation and Failure Rate

Coconut coir string requires a different process to string the canopy and affix the string to the ground but in total, the labour and time required was not significantly different. There was a small time and cost savings achieved in installation of coir string relative to poly, however it was not a difference considered significant. From an operational standpoint coconut coir was found to be a viable alternative to current industry practices at full operational scale. String failure rates continued to be similar to those observed in the crop year 2019 trial and were found to not be significantly different between poly string and coconut coir. During crop year 2020, both string materials were found to have less than one failure per 5,000 plants. All observed failures (coir and poly) were difficult to attribute to string defects versus operational causes such as implements or sheep grazing.

Image: From left to right - coir, poly & bio-hop string

String Trial – Harvest Operational Considerations

Our study found coconut coir string caused significantly fewer mechanical interruptions than poly string with the picking machinery. There was no throughput penalty or other operational problems associated with the coir string. The poly string is prone to wrapping around parts of the picker and then melting as friction causes heat build-up. This wrapping/melting problem was not present at all with the coir string and reduced both mechanical interruptions and required maintenance. It was difficult to accurately quantify the cost savings and benefits of coir in harvest operations, however they are certainly significant.

String Trial – Processing Operational Considerations

There was no discernible difference found in processing (kiln drying and pelleting) of hops grown on coir string versus poly string. The broader industry may experience benefits in processing by switching to coir as other operators are known to have much more difficulty excluding poly string from their finished hops.

String Trial – Post-Harvest Operational Considerations

There was a significant benefit to coir string found in reducing post-harvest labour through a switch to mechanical "crowning" to trim the remaining exposed bines in the field. Switching to coir string allowed for the removal of metal attachment hooks (required to anchor the poly string) from the fields. This in turn allowed for development of a mechanical crowning method. It was difficult to accurately quantify the cost savings and benefits of mechanical crowning at this point since it is still under development, however even at this stage it was clearly significant.

There was a further significant benefit achieved through being able to utilize a standard "wind-row" style composting method for all green hop waste. The coir string eliminated the need for any mechanical separation methods during the composting process and opened up a further potential pathway of providing the hop waste as fodder for sheep and beef. Work was begun on developing an efficient mechanical spreading solution to distribute the compost back out on the hop gardens and complete the cycle of reuse. Hop compost is rich in organic material because hop bines are comprised of strong fibrous material. While this is good for maintaining healthy soil conditions, it presents some challenges to efficient mechanical spreading. Initial efforts have produced a commercially efficient system which can be refined to improve time efficiency and reduce labour required.

Note: details of trial methodology may be obtained upon request from Hāpi Research

HĀPI
HOP RESEARCH CENTRE