

FARMER-RESEARCHER

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Persephone Market Garden is located near Allenford at the base of the Saugeen (aka Bruce) Peninsula, on the traditional land of the Saugeen Ojibway Nation.



RESEARCH REPORT 2021

Does intercropping with onions improve overall yield for cauliflower?

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IN A NUTSHELL

Based on observations from the 2020 growing season, Kristine wanted to test the efficacy of intercropping cauliflower with onions in their market garden.

- Kristine found that the green stem variety performed better than the white stem and Romanesco varieties.

- Kristine found no significant difference in yields or plant health between cauliflower planted alone (control) and cauliflower intercropped with onions (treatment) in either the spring or fall plantings

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MOTIVATION

Intercropping is the cultivation of two or more crops during the same season in the same field. The use of intercropping systems can provide a number of advantages for growers including: reduced risk, effective resource use, efficient labour, increased crop productivity, reduced plant diseases and pests, increased beneficial insects, increased production and profitability, and improved soil health (1).

Although intercropping is a commonly used practice on ecological farms, there is little crop specific data in the literature on the intercropping of onions and cauliflower in North America. A study from Turkey on the intercropping of onions in cauliflower found that net income increased in the system but there was no significant difference in the overall yield or crop characteristics of cauliflower intercropped with onions compared to the control (2).

In spring 2020, Kristine had cauliflower in two side-by-side beds. One was just cauliflower; the other was extra transplants of cauliflower intercropped with artichoke and extra transplants of onions. The intercropped cauliflower did much better, despite very similar, though not exactly the same, treatment for weeding/mulch. This left Kristine curious about whether it was the intercropping that might have made the difference!

To test the efficacy of intercropping cauliflower with onions, Kristine looked at three varieties of cauliflower: green stem, white stem, and Romanesco planted without onions (control) or with onions (+ onions) over two planting times spring and fall (Photo 1).

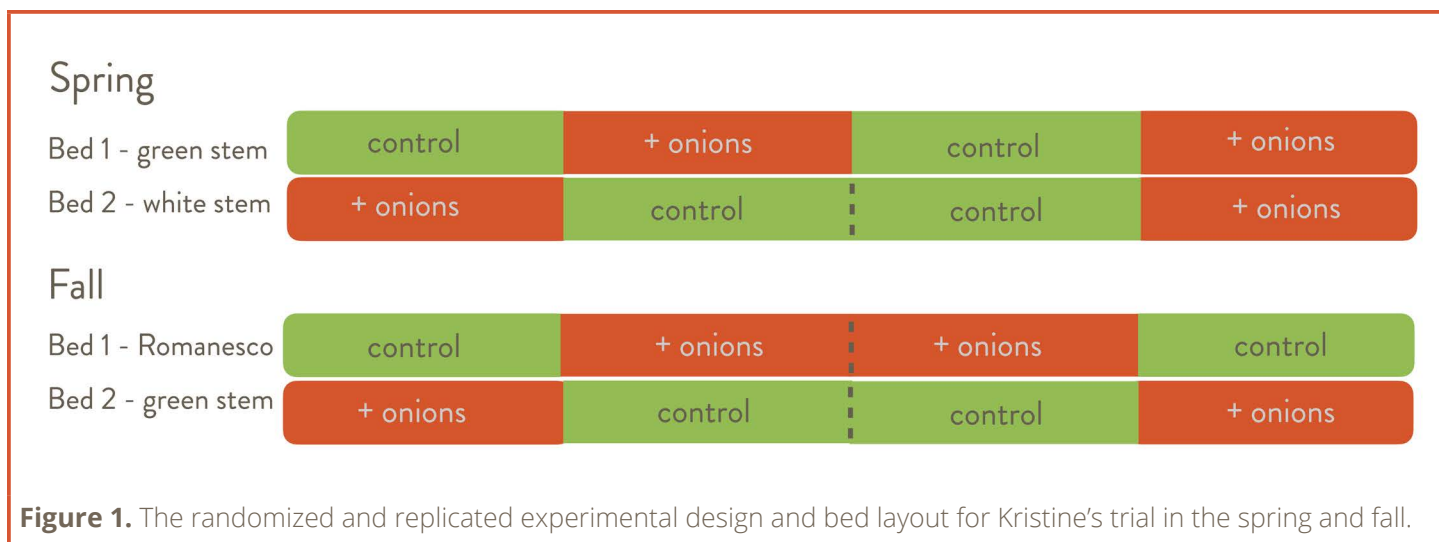
METHODS

Kristine laid out her experiment on beds 100' long and with 5' centres, with 2 rows of cauliflower per bed with 1.5' spacing. For spring,

Kristine randomly assigned 2 beds to have 1 bed of green stem and 1 bed of white stem. For fall, Kristine randomly assigned 3 beds to have 1 bed of green stem, 1 bed of white stem and 1 bed of Romanesco. Unfortunately, due to a storm, the bed of white stem in the fall planting did not survive. For each planting date Kristine divided the bed into 4 x 20'



Photo 1. Frieda inspecting the fall bed of green stem cauliflower.



increments and randomly assigned each pair of increments to either cauliflower with no onions (control) or cauliflower interplanted with onions (+ onions) (**Figure 1**). This layout allowed for ~ 8' of wiggle room so Kristine could avoid the ends/edge of the beds for the trial.

Kristine chose varieties that she was familiar with and that fit her production needs. For cauliflower, Kristine chose Song TJS-65 from Johnny's Selected Seeds (green stem; **Photo 2**), Goodman from High Mowing (white stem), and Veronica from Johnny's Selected Seeds and High Mowing (Romanesco).

For onions, Kristine chose Nabechan from Johnny's Selected Seeds (Negi onions), which are scallions grown singly that grow larger than a regular scallion and deep like a leek. The timing of growing Negi fits well with cauliflower and was flexible,

meaning Kristine could harvest the onions at a range of sizes.

Kristine measured the yield and quality of heads at each harvest by taking the total weight and total number of harvested heads, as well as the marketable weight and number of marketable heads for harvest in each plot (**Photo 3**). Kristine also determined the average head weight for each plot, and assessed plant health over the harvest dates using the rating system of very healthy, moderately healthy, unhealthy.

DATA ANALYSIS

To evaluate the effect of intercropped onions on the total weight and number of cauliflower heads and the marketable weight and number of cauliflower heads, we used a statistical model called analysis of variance (ANOVA) with

a 90% confidence level to calculate the least significant difference (LSD) needed to call the treatments "statistically different". We also tested the effect of yield using a T-test with a 90% confidence level.

Using a 90% confidence level means that if we measure a difference between any two treatments that is greater than the calculated LSD, we expect this difference would occur 9 times out of 10 under the same conditions. In this case, we consider the difference reliable and refer to the results as statistically significant. On the other hand, if we measure a difference between any two treatments that is less than the calculated LSD, we consider these treatments unreliably different or statistically similar. We could make these statistical calculations because Kristine's experimental design involved replication of the treatments (**Figure 1**).



Photo 2. Fall green stem cauliflower with Negi onions.



Photo 3. Marketable head of green stem cauliflower before harvest.

Table 1. Yield results for **spring** cauliflower grown alone (control) and with intercropped onions (treatment).

	TOTAL YIELD (LBS)	TOTAL YIELD (# OF HEADS)	MARKETABLE YIELD (LBS)	MARKETABLE YIELD (# OF HEADS)	AVERAGE WEIGHT PER HEAD (LBS)	% MARKETABLE (LBS)	% MARKETABLE (HEADS)
Control (control)	14.46	16	13.53	14	0.93	94	92
Treatment (+ onions)	16.44	18	15.05	16	0.90	90	89
P-value	0.61	0.42	0.66	0.52	0.64	0.23	0.19
LSD	NS	NS	NS	NS	NS	NS	NS

*NS = not significant

FINDINGS

There was a significant difference between plantings (P=0.005) so data was analysed separately for the spring and fall plantings.

Spring

Yields

Kristine found no significant difference between cauliflower intercropped with onions and cauliflower grown on its own for any of the yield measurements taken in the trial (**Table 1**).

For two cauliflower varieties grown in the spring, she did find significant differences in marketable yield weight (P=0.07, LSD=6.66), average weight per head (P=0.01, LSD= 0.11), and percent marketable yield weight and heads (**Table 2**). In this instance, the green stem variety produced on average 10% more marketable product than the white stem variety.

Plant Health

In the spring, Kristine found no significant differences in plant health between the treatments. Both treatments had similar numbers of plants that were very healthy (P=0.28), moderately healthy (P=0.23), and unhealthy (P=0.87) (**Figure 2**).

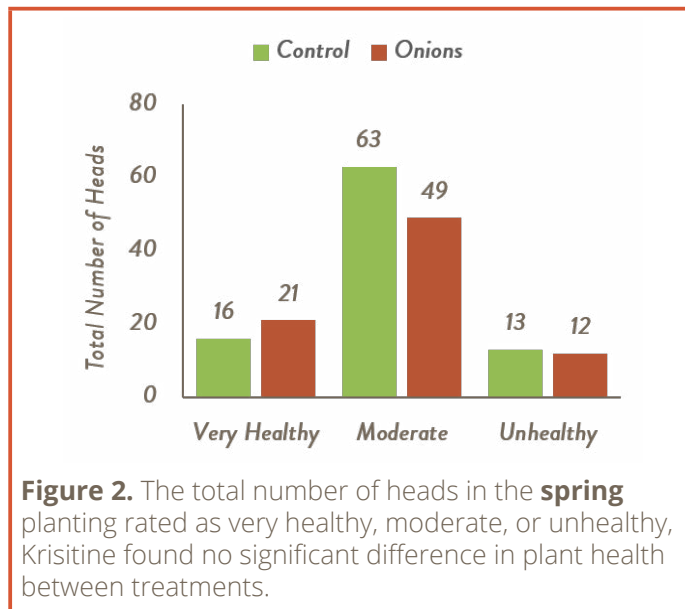


Figure 2. The total number of heads in the **spring** planting rated as very healthy, moderate, or unhealthy, Kristine found no significant difference in plant health between treatments.

Table 2. Yield results for **spring** grown varieties of cauliflower.

	TOTAL YIELD (LBS)	TOTAL YIELD (# OF HEADS)	MARKETABLE YIELD (LBS)	MARKETABLE YIELD (# OF HEADS)	AVERAGE WEIGHT PER HEAD (LBS)	% MARKETABLE (LBS)	% MARKETABLE (HEADS)
White Stem	12.06	16	10.43 a	13	0.79 a	87 a	85 a
Green Stem	18.83	18	18.14 b	17	1.04 b	97 b	95 b
P-value	0.12	0.42	0.07	0.22	0.01	0.01	0.01
LSD	NS	NS	6.66	NS	0.11	5	5

*NS = not significant **Different lowercase letters represent significant differences between varieties, P-values in orange text.

Table 3. Yield results for **fall** cauliflower grown alone (control) and with intercropped onions (treatment).

	TOTAL YIELD (LBS)	TOTAL YIELD (# OF HEADS)	MARKETABLE YIELD (LBS)	MARKETABLE YIELD (# OF HEADS)	AVERAGE WEIGHT PER HEAD (LBS)	% MARKETABLE (LBS)	% MARKETABLE (HEADS)
Control (control)	23.03	15	22.53	15	1.39	97	96
Treatment (+ onions)	22.14	16	22.14	16	1.24	100	100
P-value	0.71	0.91	0.87	0.73	0.24	0.23	0.21
LSD	NS	NS	NS	NS	NS	NS	NS

*NS = not significant

FINDINGS CONT...

Fall

Yields

In the fall, Kristine found no significant difference between the intercropped treatment and the control for any of the yield measurements taken in the trial (**Table 3**).

Between varieties, she found significant differences in total and marketable yield weight ($P < 0.001$, $LSD = 4.53$ and 4.43 respectively), total and marketable yield for number of heads ($P = 0.002$, $LSD = 4$), and average weight per head ($P = 0.001$, $LSD = 0.23$) (**Table 4**). The green stem variety produced an average of over 4x more marketable weight and over twice the number of heads when compared to the Romanesco variety.

Plant Health

In the fall, Kristine found no significant differences in plant health between the treatments for very healthy ($P = 0.54$), moderately healthy ($P = 0.16$), and unhealthy ($P = 0.39$) plants (**Figure 3**).

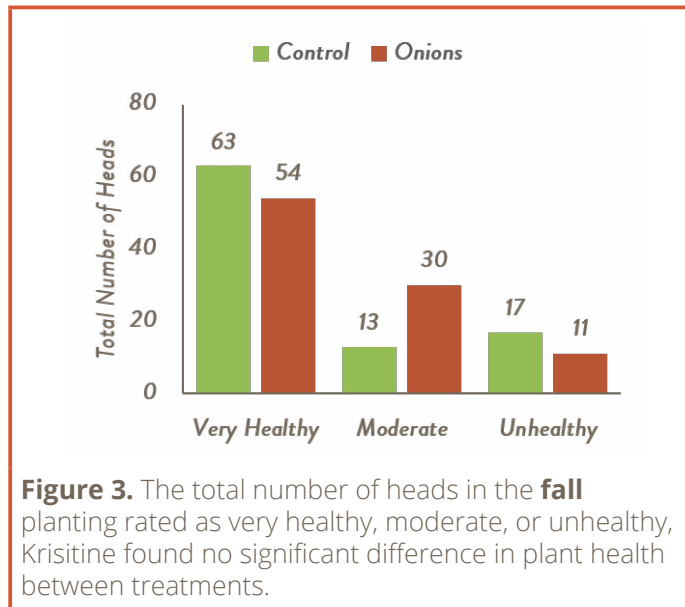


Figure 3. The total number of heads in the **fall** planting rated as very healthy, moderate, or unhealthy, Kristine found no significant difference in plant health between treatments.

Table 4. Yield results for **fall** grown varieties of cauliflower.

	TOTAL YIELD (LBS)	TOTAL YIELD (# OF HEADS)	MARKETABLE YIELD (LBS)	MARKETABLE YIELD (# OF HEADS)	AVERAGE WEIGHT PER HEAD (LBS)	% MARKETABLE (LBS)	% MARKETABLE (HEADS)
Green Stem	36.64 b	22 b	36.34 b	21 b	1.73 b	99	99
Romanesco	8.53 a	9 a	8.33 a	9 a	0.91 a	98	98
P-value	<0.001	0.002	<0.001	0.002	0.001	0.56	0.60
LSD	4.53	4	4.43	4	0.23	NS	NS

*NS = not significant **Different lowercase letters represent significant differences between varieties, P-values in orange text.

NEXT STEPS

Kristine is curious about the long term impacts of intercropping onions. Her understanding is that the cauliflower is non-mycorrhizal, while onions do form relationships with mycorrhizal fungi.

Do the onions help keep fungal populations going during non-mycorrhizal crops?

What are the soil health impacts down the road?

Kristine will continue to intercrop onions with cauliflower and will watch for general soil health and crop health improvements, as onions provide a little extra income while not suffering yield loss on the main crop.

TAKE HOME MESSAGE

Kristine found that the green stem variety of cauliflower produced better than the white stem or Romanesco varieties that they planted. We are unable to say whether these differences in variety are due to cauliflower type or variety specifics.

Intercropping onions with cauliflower did not negatively affect cauliflower yield or marketability; it provided another salable crop from the same area without being overly competitive, increasing the land use efficiency of the beds. Having found no negative effect on cauliflower yield, Kristine is inclined to keep intercropping onions with their cauliflower and to observe what happens over time.

ACKNOWLEDGEMENTS

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REFERENCES

1. Ouma & Jeruto. 2010. Sustainable horticultural crop production through intercropping: The vase for fruits and vegetable crops: A review. doi:10.5251/abjna.2010.1.5.1098.1105.
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