

Integrating Living Mulch on Vegetable Farms in South Dakota: 2024 Results



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Introduction

Tillage is currently an essential practice for non-chemical weed control on many vegetable farms. In the Great Plains region, a new option to reduce weed pressure and tillage is being explored. Clover living mulch is a perennial cover crop that is grown in the pathways between vegetable production rows that would normally be tilled. However, the use of a living mulch can cause a reduction in yield since the clover can compete for light, water, and nutrients with the cash crop (Bruce, 2022). Two vegetable farms, Haroldson Farms (HF) in Bruce, SD and Blue Sky Vegetable Co. (BSVC) in Worthing, SD, have participated in the on-farm trials since 2023 to see how implementing clover living mulch pathways may benefit their farms.

Research Objectives

On-farm research was conducted over the summer months of 2024 at two farms in Bruce and Worthing, SD. The objective of this study was to determine the impact of two established clover species on weed suppression, crop growth, and yield of severable brassica species.

Materials and methods

Research Treatments

The clover cultivars used for living mulch were 'Domino' white clover (WC) (*Trifolium repens*), and 'Dynamite' red clover (RC) (*Trifolium pratense*). The third treatment was bare ground (BG) control. Cash crops were planted into

plastic that had been laid beforehand to control in-row weed competition.

Clover Establishment

Due to a dry summer during the growing season clover did not establish well at either site (Ruen, 2024). Clover living mulch and an oat nurse crops were replanted during the 2024 growing season at both farm locations.

HF tilled all plots on April 4, 2024 and laid landscape fabric prior to planting the clover and oat nurse crop on April 25, 2023 (Figure 1). Clover and oats were planted using a Jang seeder. Rain was plentiful so there was no irrigation on the clover and oats after seeding. Two mowing and weeding events took place to knock down weeds in all treatments on June 16 and July 16 (Figure 2).



Figure 1. Landscape fabric laid after tilling all treatments at Haroldson farms. Photo courtesy of Kyle Haroldson.



Figure 2. Pathways being mowed to knock down weeds and allow light to reach clover. Photo courtesy of Kyle Haroldson.

BSVC tilled all plots prior to planting clover and oat nurse crop which was planted March 22, 2024. Clover and oat nurse crop were planted using a drill. The clover established well and had abundant rain, so no irrigation took place. Black plastic mulch was laid prior to planting clover and oat seed. One mowing event was used to prevent weeds from producing seeds and to allow more light to reach clover in the RC and WC treatment and there was one hand weeding event.

Cash Crops Evaluated

Several Brassica varieties grown in 50 foot rows were chosen by the two farms which perform well in their local market. Some of the cultivars that were grown on the farms were 'Imperial' broccoli, 'Caraflex' cabbage, and 'Twister' cauliflower. Cash crops were planted at HF May 15 and 17. A windstorm damaged all cabbage and cauliflower transplants, so harvest data was only taken on broccoli which had some replacement transplants for damaged plants on July 17 and August 7. At BSVC, cash crops were transplanted April 25 into black plastic mulch.

Clover Growth and Weed Suppression Assessment

Oat, Clover, and weed biomass were assessed five times throughout the season. A 25 by 25 cm square PVC quadrat was randomly tossed three times in the BG, KC, and RC treatments. Three random oat, clover, and weed plants were measured from the base to the leaf tip. Oat, clover, and weed plants were then cut as close to the ground as possible and separated by plant type into labeled paper bags. The paper bags were then put in a dryer for at least 48 hours at 140 degrees Fahrenheit (60 degrees Celsius) before determining biomass dry weight to the nearest 0.1g.

Results

The following results from this on farm study were not replicated and is observational only. At BSVC there were some crops planted in three rows which allowed for statistical analysis, but there was no randomization which limits the ability to infer data farther.

Clover and Weed Biomass

HF had a little difference in the average height of the oats throughout the growing season (Table 1). As expected, RC was on average taller than WC since RC is an upright growing plant versus WC which lays on the ground and spreads from the initial growth point. There was little difference in weed height throughout the season. The weight of oats was higher in the RC treatment by 136.7 pounds per acre which may correlate to the slightly taller average height. RC had almost 500 pounds per acre more biomass than WC. Both RC and WC had decreased the biomass of weeds substantially compared to the BG treatment. WC performed best when I came to weed biomass suppression.

Table 1. Oat, clover, and weed biomass collected during the 2024 growing season at Haroldson Farms. BG = Bare Ground, WC = White Clover, RC = Red Clover.

Treatment	Height Oats	Height Clover	Height Weeds	Weight Oats	Weight Clover	Weight Weeds
BG	0	0	9	0	0	1873
WC	6	7	8	350	707	782
RC	7	9	8	487	1202	962

BSVC had a greater difference in the average height of the oats throughout the growing season (Table 2). As expected, RC was also on average taller than WC. The weeds in WC were slightly taller than the weeds in BG and RC. The weight of oats was higher in the RC treatment by 73.6 pounds per acre which may correlate to the slightly taller average height. RC had almost 400 pounds per acre more biomass than WC (Figure 3). Both RC and WC had decreased the biomass of weeds substantially compared to the BG treatment (Figure 4). WC performed best when it came to weed biomass suppression.

Table 2. Oat, clover, and weed biomass collected during the 2024 growing season at Blue Sky Vegetable Co. BG = Bare Ground, WC = White Clover, RC = Red Clover.

Treatment	Height Oats	Height Clover	Height Weeds	Weight Oats	Weight Clover	Weight Weeds
BG	0	0	5	0	0	851
WC	4	6	8	171	835	544
RC	5	8	6	245	1216	664

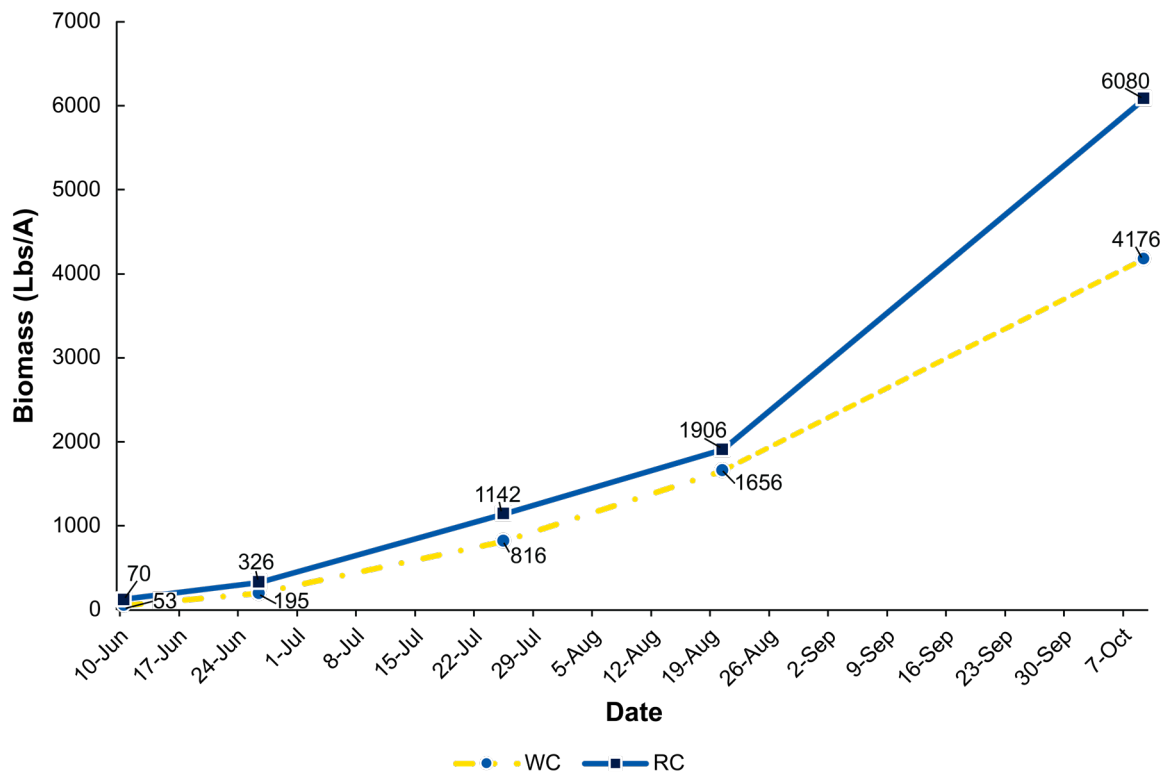


Figure 3. Clover biomass accumulation during the 2024 season at Blue Sky Vegetable Co.

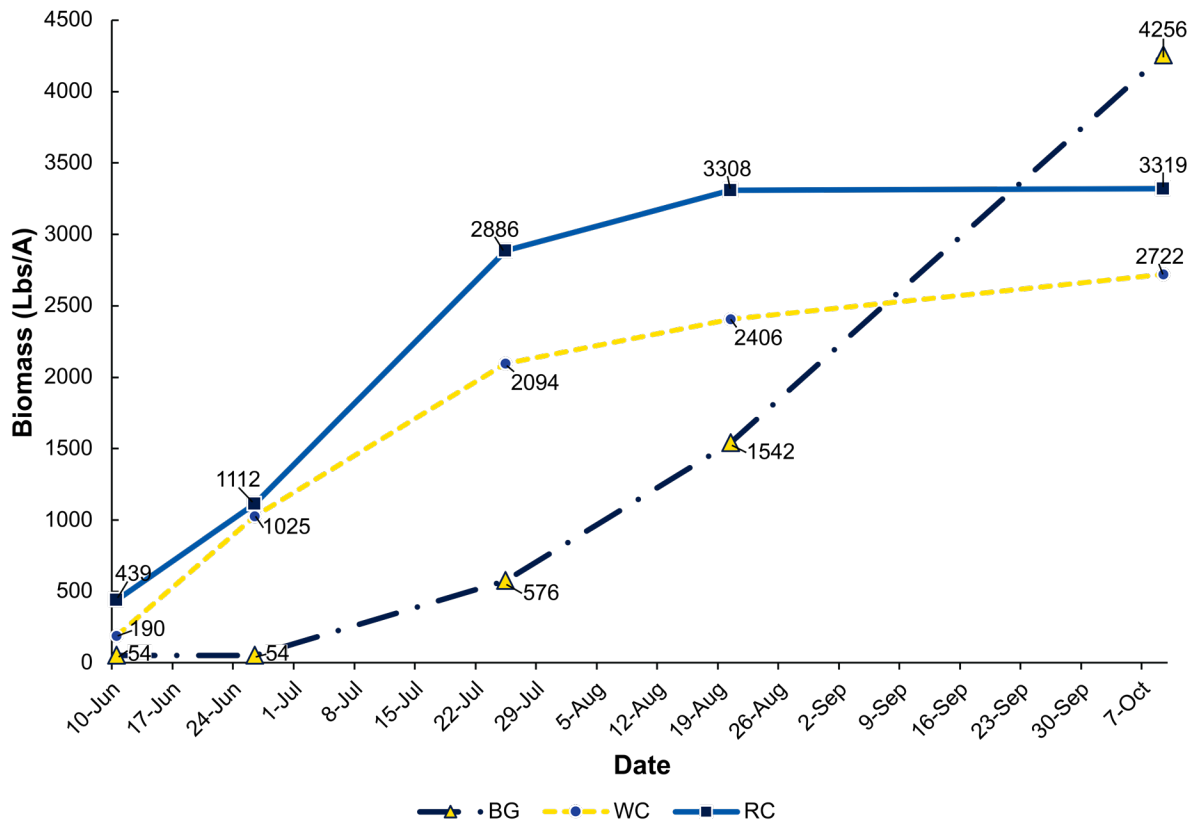


Figure 4. Weed biomass accumulation during the 2024 season at Blue Sky Vegetable Co.

Cash Crop Harvest and yield data

Because of the wind damage, broccoli was the only crop that could be harvested at HF. RC and WC plots both had 0.9 kilograms of marketable broccoli harvested per plant while BG plots only resulted in 0.6 kilograms per plant (Table 3). There may have been more replaced transplants in the BG treatment which caused a decrease in harvested broccoli (Figure 5).

Table 3. Total marketable weight of broccoli per plant harvested at Haroldson Farms.

Clover	Variety	Per plant
BG	Broccoli	0.6
RC	Broccoli	0.9
WC	Broccoli	0.9



Figure 5. Marketable head of broccoli harvested at Haroldson Farms. Photo courtesy of Kyle Haroldson.

BSVC had a significant reduction in the total count and weight of marketable ‘Caraflex’ cabbage harvested in the RC and WC treatments (Table 4). There were no significant differences in unmarketable categories (Figure 6). There was no significant difference in the count of harvested marketable ‘Imperial’ broccoli but there was a significant difference in the average weight per harvest event in the RC and WC treatments compared to BG (Table 5). The marketable weight per plant of ‘Nautic’ brussels sprouts was very similar with both BG and WC plots resulting in 0.19 kilograms harvested per plant while RC had 0.17 kilograms per plant (Table 6). The average weight of 20 brussels sprouts favored BG with 116.3 grams while WC had 92.7 grams per 20 sprouts. WC greatly reduced the average marketable count and weight of heads of ‘Twister’ cauliflower (Table 7). RC also resulted in a large reduction in total count and weight of cauliflower harvested. The count and weight of unmarketable heads was similar in BG and WC, but the marketable yield hit was substantial in the clover treatments.



Figure 6. ‘Caraflex’ cabbage harvested at Blue Sky Vegetable Co. Photo courtesy of Kjersten Oudman

Table 4. Average total marketable count and weight (Kg) per row 50 foot of ‘Caraflex’ cabbage harvested three times from July 2 to 17, 2024 at Blue Sky Vegetable Co, Worthing, SD.

Clover	Marketable		Insect Damage		Split Heads		Diseased		Too Small	
	No.	Wt. (Kg)	No.	Wt. (Kg)	No.	Wt. (Kg)	No.	Wt. (Kg)	No.	Wt. (Kg)
BG	29 a ^z	22.6 a	8	2.5	1	1.4	0	0	5	1.1
RC	20 b	18.3 b	4	7.2	0	0.3	1	0.3	5	1.5
WC	19 b	18.2 b	8	7.4	0	0.4	0	0.1	3	1.4
p-value	0.04	0.008	0.1	0.1	0.4	0.4	0.4	0.4	0.4	0.5

^zValues followed by the same letter within a column are not different from each other based on Fisher’s least significant difference test (alpha = 0.5).

Table 5. Average marketable count and weight (Kg) per harvest event from 50 foot row of 'Imperial' broccoli harvested on Jul. 4, 9, and 12, 2024 at Blue Sky Vegetable Co., Worthing, SD.

Clover	No.	Wt. (Kg)
BG	11	2.5 a ²
RC	9	0.7 b
WC	8	0.8 ab
p-value	0.6	0.03

²Values followed by the same letter are not different from each other based on Fisher's least significant difference test (alpha = 0.5).

Table 6. Marketable weights of 'Nautic' Brussel Sprouts Harvested at Blue Sky Vegetable Co.

Clover Treatment	Total Marketable Weight (Kg)	Weight per plant (Kg)	Average Weight per 20 Sprouts (g)
RC	5.95	0.17	101.2
BG	6.02	0.19	116.3
WC	7.96	0.19	92.7

Table 7. Average Total Marketable Count and Weight per 50 Foot Row of 'Twister' Cauliflower Harvested at Blue Sky Vegetable Co.

Clover	Marketable		Unmarketable	
	No.	Wt. (Kg)	No.	Wt. (Kg)
BG	21	17.1	1	1.0
RC	13	5.0	7	3.0
WC	2	0.9	2	0.5

Farmer Observations

HF owner, Kyle Haroldson, said that the clover grew much better than it did last year, which helped to reduce weed pressure. The early moisture early in the season helped get the clover established and growing right away to compete with weeds. Some of the challenges Kyle had was a large windstorm that killed many of the transplant early one in the season. He also noticed an increase in pest damage which may have been attributed to the clover pathways. The battle with nature this year made it difficult to quantify how the clover affected the yield of the crops.

BSVC owners, Kjersten and Dirk Oudman, saw a great benefit from the clover after receiving 18 inches of rain on their farm in 48 hour period in mid-June. The clover treatments had much better water infiltration and were stable enough to walk on while the BG treatment was too wet to walk through (Figure 7). They observed an

increase in beneficial insects which may decrease insect pressure when compared to Brassica species grown outside of the trial. The largest drawback was the effect the clover treatments had on crop size and the delay in maturity. There was a visible difference in the cash crop which was supported by the yield data that the clover causes a decrease in yield which is difficult to justify the living mulch. Mowing the clover also was not a top priority at busy times so it got taller than one would like it to. Kjersten is curious if using other non-leguminous cover crops would potentially decrease the impacts on yield. Overwintering the clover and planting cash crops in plastic mulch is difficult since you will have to disturb the clover to lay the plastic. The use of landscape fabric could be used in its place but that is more labor intensive.

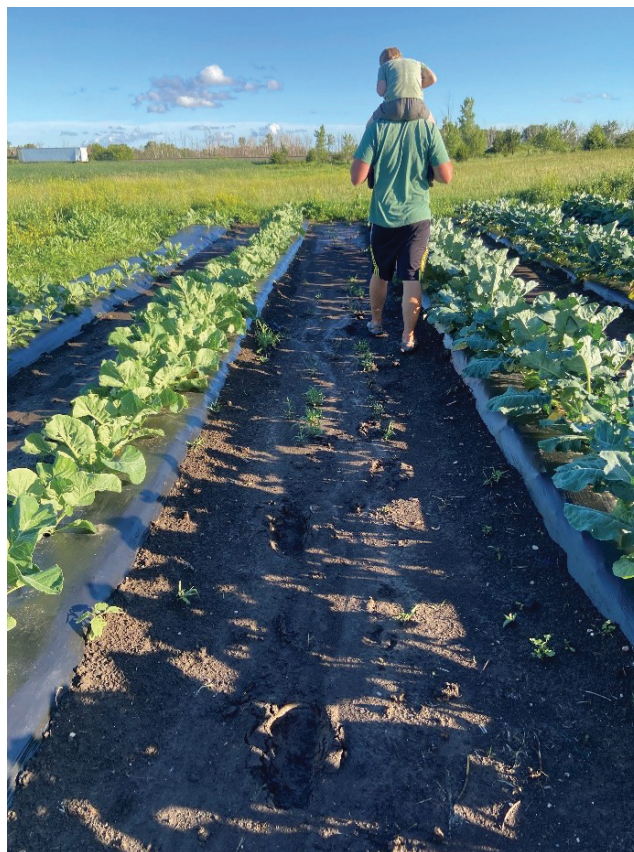


Figure 7. Footprints from walking in the BG treatment after 18 inches of rain at Blue Sky Vegetable Co. Photo courtesy of Kjersten Oudman

Conclusion

Clover living mulch can be a useful tool once established but can be difficult to get to a point where it is self-sufficient. The first months of care require ample water and TLC that can be difficult to provide when other projects are taking place on the farm. Early establishment may be the key to success to beat the weeds and allow clover to grow its long tap root which will make it less susceptible to drought stress and weed competition. Clover living mulch showed a more resilient soil once established after a large rain event at BSVC which would have limited field access with clover pathways. There is a clear yield hit to the cash crops which is troubling but there may be a better cover crop that could be used that limits this in the future. Overall, clover living mulch is a time investment that is beneficial to the soil and ecosystem of farms.

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