SoilWealth | ICP
nurturing crops · protecting crops

CASE STUDY | SEPTEMBER 2023

Replacing plastic mulch

Cover crops for weed suppression and soil health

Working with the Soil Wealth ICP team (SWICP), vegetable grower Kim Ngov (left) has been trialling cover crops as a replacement to plastic mulch on his Wedderburn farm in NSW since 2020.

Kim had previously used plastic to control weeds in his vegetable crops but was eager to reduce the use of plastic on his farm. Also wishing to improve soil health and maintain effective weed management, Kim worked with the team to trial cover crops as a more sustainable alternative.

With support from the SWICP team, Kim has managed to change his practices incrementally over time, an approach which has been pivotal to his success. Learning from each small change and tweaking his management practices as necessary, the process has been time and cost-effective.

Eliminating plastic mulch from his system has not come without its challenges, but Kim's resilience and determination has rewarded him with positive results.

KEY MESSAGES

- Cover crops effectively replaced plastic mulch to suppress weeds in-between and on the beds
- Weed levels were lower and more manageable after a cover crop than after a fallow left with weeds
- Cover crops helped to reduce erosion and improve water infiltration during seasons of heavy rainfall
- Preparing the beds for the vegetable crop before planting the cover crop can reduce time, labour and machinery costs
- Partial cover crop termination was effective for weed management and prevention of erosion, however, the cover crop competed with the vegetable crop for light and nutrients. Trials with bigger widths of termination should be considered
- Annual ryegrass was most suited to Kim's needs, faring well under the cool and wet conditions, and with its low and dense growth habit. Kim has adopted the new practice of integrating cover crops

Hort Innovation RMCG ahr applied horticultural research

This project has been funded by Hort Innovation using the vegetable and melon research and development levies and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

Australian Government | National Landcare Program

This project is supported by Applied Horticultural Research, through funding from the Australian Government's National Landcare Program.

The challenge

Plastic mulch is used widely, offering a physical barrier that prevents germination and establishment of weeds. It can also help to increase and stabilise soil temperature and maintain soil moisture levels, favouring crop growth.

While plastic is cheap, the cost of installation, removal and disposal can be considerable. It is common to leave the plastic in place for several years to reduce overall costs. However, over time the material tends to lose efficacy, with weeds able to grow through punctures in the plastic. It can also pollute the environment when breaking down.

So, what did we do?

Over three years, three demonstration trials were conducted:

1. Cover crops grown between beds (2020)
2. Cover crops grown on the beds and terminated fully (2021)
3. Cover crops grown on the beds and terminated partially (2022)

Table 1: Cover crops and the rates sown

Cover crops grown	Seeding rate
Ryegrass	20 kg/ha
Buckwheat	50 kg/ha
Ryegrass + buckwheat	20 kg/ha + 50 kg/ha
Ryecorn	120 kg/ha
Ryegrass + ryecorn	20 kg/ha + 60 kg/ha
Control	Fallow without use of herbicides

Trial 1 – Cover Crops grown between beds (2020)

In the winter of 2020, Kim and the SWICP team experimented with various cover crops to help control weeds between beds of snow peas, which were covered with plastic mulch. Five different combinations of cover crops were sown in late April and compared to a control (Table 1).

Ryegrass (Figure 1) was the standout of this trial, offering many benefits, including good competition with weeds, low growth habit to avoid shading of the vegetable crop, ground cover to prevent erosion and a muddy work environment, and improved soil health.

READ AND HEAR MORE ABOUT THIS TRIAL

- Case study
- Podcast

Figure 1: Ryegrass in the inter-row in July 2020

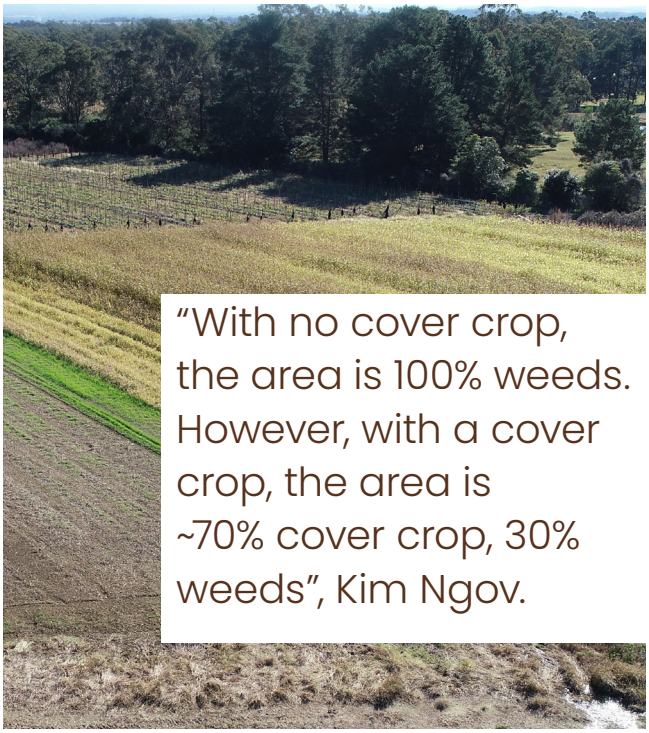
Trial 2 – Cover crops grown on the beds and terminated fully (2021)

Building on the positive experience of growing cover crops between his beds, Kim was interested in eliminating the use of plastic mulch by growing cover crops on the beds to control weeds.

Three different combinations of cover crops were selected to assess their suitability to the region and growing window, as well as their capacity to suppress weeds (Table 2). As biomass and ground cover were the main attributes sought for weed suppression, only grasses were sown.

Table 2: Cover crops and the rates sown

Cover crops grown	Seeding rate
Sorghum + ryegrass	15 kg/ha + 10 kg/ha
Sorghum	20 kg/ha
Millet	30 kg/ha



"With no cover crop, the area is 100% weeds. However, with a cover crop, the area is ~70% cover crop, 30% weeds", Kim Ngov.

Trial setup

The cover crops were sown in mid-February 2021. Due to the cooler temperatures and shorter days of autumn, the millet self-terminated after 70 days. The area was then resown to ryecorn at 160 kg/ha in early May. Unfortunately, the ryecorn seeds were eaten by birds, preventing good establishment. The areas sown to ryecorn and millet were therefore used as a control for the trial.

In mid-August the cover crops were terminated by an initial application of glyphosate, followed by paraquat four days later. The cover crops were roller-crimped three days after applying paraquat. A single ripper was used to mark planting lines for melon seedlings that were to be transplanted at the end of September (Figure 2). Unfortunately, an unseasonal frost killed most of the transplanted seedlings and wet, cool weather made replanting unsuitable.

Sorghum + Ryegrass | Sorghum

Figure 2: Cover crops after termination and strip-tillage in September 2021

Results

Weed counts and biomass assessments were carried out three times during the season (April, October, and December). Throughout the season it was evident that where cover crops were grown, weed pressure was lower than in the control plots. Interestingly, in April the sorghum cover crop had almost twice the amount of biomass as the sorghum-ryegrass mix, yet the weed counts were similar. When the second assessment was conducted, the ryegrass was starting to re-grow and sorghum volunteers (self-sown from the previous cover crop generation) were in the early vegetative stage. In December the difference in weed suppression capacity between cover crops and the fallow control was even more evident (Figure 3).

Due to the La Niña, the summer of 2020/21 and autumn 2021 were cooler and wetter than usual, with rainfall 20% higher in 2021 than the long-term average. The sorghum-ryegrass mix cover achieved the best results because of the good ground cover provided year-round by ryegrass (a winter grass, best suited to the cold and the rain) rather than the high biomass of sorghum (a summer grass), (Figure 4).

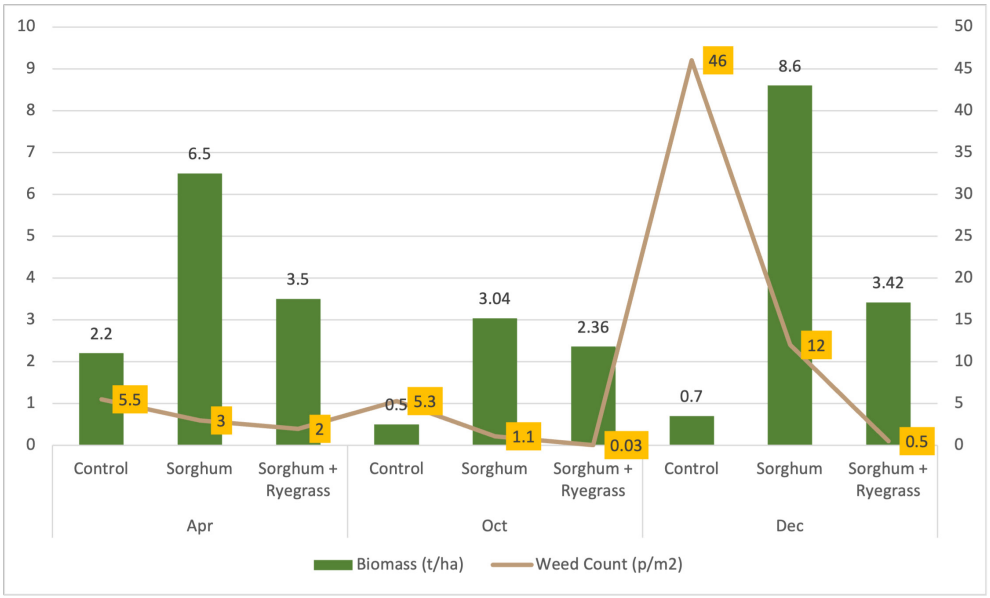


Figure 3: Biomass and weed density by treatment over the duration of the trial

Figure 4: Sorghum-ryegrass mix in December 2021 (left) and sorghum on the same date (right)

Adverse weather limited Kim's ability to grow anything in the paddocks after the cover crops, making it impossible to observe any direct effect of a cover crop on a following vegetable crop. In addition to the effectiveness of the cover crops in suppressing weeds, their impact on soil health and soil preservation was evident. During the significant rain events of 2021, the biomass of the cover crops limited erosion, while the root systems improved drainage and held the soil structure together (Figure 5).

Figure 5: Soil structure in May 2021 in the sorghum-ryegrass scenario

Trial 3 – Cover crops grown on the beds and terminated partially (2022)

Results obtained from the previous trial highlighted ryegrass as a suitable replacement for plastic mulch. The primary objective of this trial was to identify the optimal width of ryegrass to terminate - to maximise weed suppression - without the cover crop competing with the cash crop for light and nutrients.

Trial setup

Kim formed the beds and sowed the ryegrass in February 2022 at a rate of 100 kg/ha. The rapid establishment of the cover crop helped to protect the soil from erosion under the heavy rains that fell during the following weeks (almost 600 mm in less than one month). Due to the wet weather, it would have been nearly impossible to lay the plastic mulch on the beds; if it had been laid, its durability would have probably been compromised.

In April, Kim terminated strips of the cover crop with glyphoshate that were to be planted with snow peas. The spraying widths chosen for the trial were 10 cm, 30 cm and the whole bed. Due to adverse weather conditions the planting of snow peas was postponed to June 2022 (Figure 6).

10cm 30cm Whole bed

Figure 6: Beds in June 2022 after the cover crop was terminated, and snow peas planted. Terminated widths of the cover crop included 10 cm (left), 30 cm (middle), whole bed (right)

Because of the unfavourable weather the snow pea crop did not perform as hoped. Kim therefore decided to terminate the cash crop in August, followed by full termination of the whole ryegrass cover crop in October. The area was then replanted with chillies when the weather stabilised.

Results

The following trends were observed during the season:

- **10 cm**: weed pressure was heavier early on compared to other treatments, however ryegrass outcompeted weeds at later stages, also tending to compete with the snow peas for light and nutrients.
- **30 cm**: weed counts were between the 10-cm and the whole-bed treatments. The bed structure remained intact and weed suppression was adequate. **Terminating a 30-cm strip was the treatment that obtained the best results.**
- **Whole bed:** weed pressure was initially low, thanks to the herbicide used to terminate the cover crop. By August, weeds became more prominent as the ground cover was insufficient to suppress their growth. The beds had eroded, with the edges slipping away under the heavy rains and water accumulating on the surface as there was no ryegrass. As the ryegrass started to regrow it also started to compete with the snow peas (Figure 7).

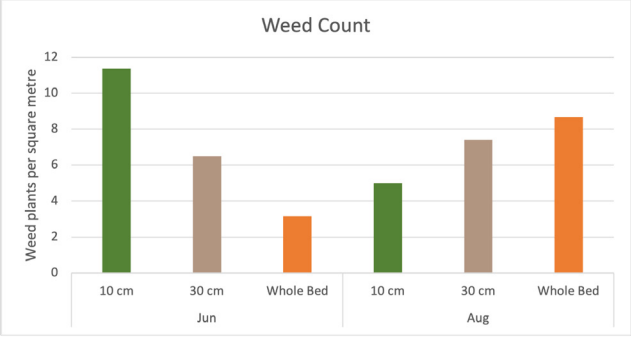


Figure 7: Weed counts per treatment over time

Crop nutrition was a challenge, with the ryegrass taking up nutrients and therefore competing with the snow peas. Despite this, the ryegrass helped store nutrients and prevent loss through leaching and denitrification, a common occurrence under extremely wet conditions.

Further results

In 2022 Kim had three different types of soil cover growing in different paddocks prior to growing cash crops on his farm, obtaining three very different results (Figure 8).

1. Long-term ryegrass cover crop (Feb-Oct) and snow peas (third trial), planted with chillies
   - Weed population was very low and sparse
   - **Strategy that obtained the best result**
   - Planting the cover crop several months before planting the vegetable crop allowed it to build sufficient biomass. After termination, the cover crop residue continued to provide effective weed control
2. Short-term ryegrass cover crop (Aug-Oct), planted with chillies
   - Manageable though heavy weed pressure, both between and on the beds
3. Fallow area, rotary-hoed and sprayed before planting zucchini
   - Unmanageable weed pressure, Kim could not keep up with the herbicide treatments, the zucchini crop was completely outcompeted

Chillies planted after long-term ryegrass cover crop

Chillies planted after short-term ryegrass cover crop

Zucchini planted after fallow

Figure 8: Photos of vegetable crops following the three different weed management strategies in March 2023

Future considerations

- Expanding on trial 3, **the width of the termination strip of the ryegrass cover crop could be increased to 40 or 50 cm**. This will help to reduce competition for light and nutrients between give the vegetable crop and cover crop, while still allowing the cover crop to grow, holding the structure of the beds, reducing erosion in the interrow, and competing with weeds.
- Kim raised concerns about snakes in the cover crop as it became dense in the interrow. This could be addressed by terminating the remainder of the cover crop, prior to trellising and harvesting activities.
- Provide **extra care to the ryegrass cover crop, including fertilising and further weed management,** such as spraying with a selective herbicide to control broadleaf weeds to help the establishment of the cover crop.
- After termination of the cover crop, a light **strip-ripping of the soil where the vegetable crop is to be planted,** could be beneficial to improve drainage and help to manage soil-borne diseases, while maintaining most of the over crop residue.
- **Different ryegrass cultivars (early vs late maturing) could be trialled**.
- **Continue trialling and assessing** the effectiveness of cover crops as an alternative to plastic mulch over different seasons and years.
- **Collect vegetable crop yield data** over different seasons and years.
- **Keep some beds with the conventional practice** (plastic mulch) **to compare its performance** with the new practice.

ACKNOWLEDGEMENTS

The Soil Wealth ICP team would like to thank grower Kim Ngov for his willingness to host a demonstration site and his continued efforts to improve his farming practices.