

草毯種植讓文旦果園變得很不一樣

游振葦^{1,*}、林立²、徐仲禹²

¹興瑞文旦農場農場主

²花蓮區農業改良場助理研究員

*e-mail: smallcat325@gmail.com

摘要

102年，我的父親在果園拉農藥管線時，藥管無預警炸開，造成他中毒緊急送醫並住院一週。在經過多方思考後（如：農業人員長期接觸農藥影響、年青回鄉、機械化時代、人口老化、經驗斷層、環境氣候土壤改變、栽種模式改變等），我回到故鄉瑞穗，繼承未曾想過的家業。

本著改變父親工作環境的初心，加上農藥味令人難受，我選擇有機栽種，並向花蓮農改場詢問有機栽種文旦的相關問題。原以為不必再接觸農藥是一件非常高興的事，但現實往往不如想像美好，初期光是雜草的生長，就讓我喘不過氣來。曾想過購買乘坐式砍草機，但果園地質是河床地，上面只有少量客土，加上搬運車長年行走，已造成土壤夯實，彷彿水泥路，也發現樹根部份浮出表面。所以我回來後改為人工拉管的方式，希望使土壤恢復鬆軟，但經常性砍草，讓原來濕潤的環境及鬆軟的土壤，很快又過度夯實。

一個偶然的機緣下，花蓮農改場提出「生態系統服務」的概念，邀請我提供三分地來協助實驗，深入了解後，發現此概念對於我想創造果園食物鏈的環境及使土壤鬆軟的目標可以相互結合，我便投入這次的實驗。

種植過程中，草毯開始生長前，早晚必須仔細灌溉，隨著時間過去，草毯漸漸長出嫩芽，慢慢地向外延伸，果園消滅雜草的工作竟慢慢減少。

實驗結束已經三年，我在果園觀察出草毯驚人的成果，例如：

1. 太陽無法直射土壤，水份蒸發少。

太陽照射草毯的區域，額外水份供給量少，以往在夏季幾乎天天都必須幫作物澆水，大雨後也只能撐約莫三天。但種植草毯後，補水的時間延長了，夜晚濕度高時，草毯可以保留露水，草毯跟土壤間保持穩定的濕度及溫度，也形成一種微氣候，有助於土壤共榮的微生物、昆蟲及動物，當然文旦也是受益者。在颱風或大雨來臨時，草毯的根系或許會把水份帶到較深層的土層，減少積水、疫病等後續問題，且草毯表面有阻力、葉面能緩衝雨水，能夠減少土壤流失，降低病菌飛濺的可能。

2. 減少碳發揮，以及深耕土壤層。

在接觸草生栽培後，發現以往砍完雜草後，表面雖然乾淨又有有機質可以提供，但草毯本身高度不影響農作而不用砍草，因此根系汰換後，在土壤裡能間接被微生物分解，再被作物吸收，不會因接觸空氣而減少碳的流失，且可以藉由蚯蚓等昆蟲深耕引誘作物根系往下。

3. 作物環境溫度穩定，不會有較劇烈變化。

果園環境不適合犁耕、穴施等施作，因此在草毯的遮陰下，表面肥料維持一定濕度，加速微生物對肥料的分解，地表的溫度也能維持穩定，有助於減少作物根系受劇烈變化影響。在夏天 33 度的環境下，同一時間測出草毯溫度降有 28 度左右，而冬天寒流 9 度的環境下，測得的溫度為 15 度。

4. 降低與動物的衝突。

夏天最怕遇到的動物就是蛇，每個地區蛇的種類都不同，我的果園裡，出現的是南蛇和眼鏡蛇。一般雜草長得較高阻擋視線，人與蛇之間，容易產生衝突。在種植草毯後，草的高度降低，蛇跟人彼此的能見度變高了，衝突自然減少。

5. 人工砍草省時省工。

經過種植草毯後，不必定期砍草，也就不必再定期支出機具、油料、維修費用等，是一大好處。

6. 改變昆蟲生活習慣。

例如螞蟻在土地上，一能分解昆蟲屍體，並帶回巢穴提供食物，二能圈養蚜蟲或介殼蟲，趕走瓢蟲等天敵，順利取得蜜露。草毯建立後，使得大多數的昆蟲更靠近地面生活，自然也會讓螞蟻改變生活習性。草毯種植 5 年後，居住在草毯中的昆蟲，竟也開始吃原本不愛的草腥草葉片。此外，毛毛蟲大部份在草毯裡生活，也讓作物的葉片損失變小。耐陰的魚腥草是果園裡生長良好且穩定的草種，有些毛毛蟲也在魚腥草上取食生存，因此提供了姬蜂和小繭蜂等寄生性天敵食物來源，使得果園寄生蜂族群種類增加，鱗翅目害蟲（毛毛蟲）受到食物鏈壓制。其他如蜻蜓、食蚜蠅、螳螂、蝙蝠等動物也漸漸在果園中出現。從事有機栽種開始，土壤中的蚯蚓從無到筆芯大小，到從事有機栽種七年後的現在，已經長到小姆指這般大，讓我驚訝不已。

雜草就像是「大地保護者」，不只保護了土壤、作物，也保護了依土地而生的生命們。但雜草生長得太高太快，對於果園維護，耗神耗力，儘管雜草的根系深度，有助於含水量的多寡，但也因頻繁砍草、機械壓實、積水、施肥不當、有機質不足等因素，以至於對作物生長帶來負面影響。適度降低雜草高度能帶來許多

益處，利用草毯能有效維護土壤健康與生態環境、增進作物品質及產量，雖營造初期費工耗時，但後續的管理相對容易，是果園草相管理的好選擇。

關鍵詞：文旦、生態系統服務、草毯

Sod Planting Differentiates Pomelo Orchards

Zhen-Wei You¹, Li Lin² and Chung-Yu Hsu²

¹Xingrui Pomelo Farm, Farmer

²Hualien District Agricultural Research and Extension Station, Assistant Researcher

Abstract

In 2013, my father was poisoning and hospitalized because of an unexpected explosion accident that occurred in our orchard while he was laying pesticide pipelines. After deeply thinking (such as long-period pesticide contacting, home returning of young people, mechanized age of agriculture, experience fault, climate and soil condition changing, and planting mode changing), I decided to return home to work in the agricultural industry, something I had never considered doing.

To change the agricultural environment for my father and the fact that I dislike the smell of pesticides, I decided to join the Organic Certification scheme after some inquiry at the Hualien District Agricultural Research and Extension Station. At that time, I believed that organic farming, which would enable me to avoid pesticides, would make me happy. However, not everything is perfect in the organic agricultural industry. The problem of weeds alone left me feeling suffocated. I considered buying a riding lawn mower. However, the geology of the farm is that of a river bed. Only a small amount of imported soil remained on the farm land. Additionally, the frequent movement of trucks on the farm lands throughout the year had resulted in the compaction of soil. Walking on the compacted soil resembled walking on a cement pavement. I also discovered that some of the tree roots had emerged on the ground surface. Therefore, I manually laid the pesticide pipelines in the hope of softening the soil and returning it to its original state. However, the frequent weeding had caused the originally soft and moist soil to become hard and dry.

Fortunately, the Hualien District Agricultural Research and Extension Station proposed the concept of “ecosystem service,” and they requested 0.29 ha of my land to assist with the relevant experiments. After gaining an understanding of this ecosystem service, I realized that it could be combined with the methods that I hoped to employ for softening the soil and creating a food chain environment. Thus, I agreed to assist with the experiment.

During the planting process, morning and evening irrigations were compulsory before the sods started growing. Later, the sod shoots emerged from the ground and

began to gradually extend outward. As the shoots spread, the weeding work in our orchard gradually decreased.

After 3-years completion of the experiment, I found out surprising benefits of sod planting and as described in the following sections.

1. **The sun was unable to shine directly on the soil, resulting in less water evaporation.**

I discovered that I could reduce water usage in the areas where the sun shined directly on the sods. Previously, I had to water the crops almost daily during the summer season. Even when it rained, the longest interval between crop watering was approximately 3 days. However, after planting the sods, the interval between crop watering widened. During times of high humidity, the sods capture the dew. In that manner, a stable humidity and temperature is created between the sods and the soil, forming a microclimate that is beneficial for the growing of microorganisms, insects, and animals that exist symbiotically with the soil. Of course, the pomelo crops have also benefitted from the said microclimate. When typhoons or heavy rainfall occurs, the root system of the sods transport the moisture to deeper soil levels, which in turn reduces subsequent problems, such as standing water and diseases. Additionally, the surface of the sods provides resistance to water movement. Therefore, the water flowing out from the sods are clearer, which can mitigate soil loss. The rainwater also does not result in splattering of pathogenic bacteria because of the lack of direct contact with the top soil. Finally, the foliage can also help to mitigate the compaction of soil caused by rainwater.

2. **Reduced carbon evaporation and deep tillage of the soil layers.**

After engaging in weed cultivation practices, I discovered that although my previous weeding efforts maintained the ground surface clean and provided me with organic material, the height of the sods did not affect the farming operations; thus, no weeding is required with the planting of sods. After the root system is discarded and replaced, the root system is decomposed indirectly by microorganisms and absorbed by crops; therefore, no carbon loss occurs because of exposure to the air. Additionally, the roots of the crops can be stimulated to grow downward through deep tillage by insects, such as earthworms.

3. **Stable environmental temperature and the lack of drastic temperature changes for the crops.**

Ploughing and drill-hole fertilization are unsuitable for the pomelo farmland. Therefore, under the shading of the sods, a certain level of moisture can be retained on the surface of the fertilizers; this accelerates the decomposition of fertilizers by the microorganisms. The temperature on the ground surface can also be maintained at a stable level. Growing under a stable temperature helps reduce the influence of drastic temperature changes on the crop's root system. During summer, with temperatures commonly reaching 33°C, the temperature of the sods was measured to be 28°C at the same time. During cold fronts in winter, the air temperature was only 9°C; however, the temperature of the sods was 15°C.

4. **Reduced conflicts with animals.**

The most commonly encountered animal in the summer is snakes. Different snake species live in each area. The snakes that most commonly appear on my farms are oriental rat snakes and cobras. Encounters between snakes and humans are more likely when the weeds are tall. After the planting of sods, the height of the weeds was reduced. As a result, snakes and the humans can see each other clearly, which naturally reduces the possibility of conflict.

5. **Manual weeding saves time and effort.**

After the planting of sods, I no longer have to weed regularly. Additionally, I do not have to sustain the cost of machinery, fuel, and maintenance associated with regular weeding.

6. **Changing the living habits of the insects.**

For example, ants disintegrate the remains of insects and transport them back to their nest for food thanks to sod planting. The sods also protect the aphids or scale insects, enabling them to successfully obtain the nectar they require. Therefore, most of the insects have been living below ground after the establishment of the sods. Naturally, this would change the living habits of ants. The insects would also live in the sods. Five years after the planting of the sods, the leaves of fishwort, which insects do not typically feed on, have become a source of food for them. Even the caterpillars live inside the sods most of the time, resulting in less leaf-related loss in the crops. Five years after the planting of the sods, the shade-tolerant fishwort has become a grass species that grows stably in the park. Some caterpillars also feed and survive on fishwort, and these caterpillars serve as a food source for their parasitic natural predators, such as ichneumon wasps and braconid wasps. The abundance of food in the farm land area has caused the

number of parasitic wasp species to increase. Consequently, the number of lepidopterous pests (caterpillars) has been suppressed, and insects and animals such as dragonflies, hoverflies, praying mantises, and bats are also increasingly sighted on the farm. Earthworms, which were originally nonexistent in the orchards, have reappeared since organic cultivation, grew to the size of pencil lead, and are now the size of little finger; that was a pleasant surprise.

Finally, in my 7-year organic farming journey, I have realized that weeds are the guardians of the earth; they not only protect the soil and the crops but also protect other organisms. However, because weeds grow rapidly, they would cause some inconvenience if certain manual farming practices are employed. Therefore, a moderate lowering of the weed height would be beneficial. The depth of the weeds' root system determines the water content. However, the growth of the crops can be undermined because of factors such as frequent weed removal, mechanical soil compaction, stagnant water, inappropriate fertilization, and insufficient organic material. Sods can be used to maintain soil health and the ecological environment as well as to enhance the quality and yield of the crops. Although the initial stages of sod planting are time-consuming, the subsequent management is relatively straightforward. Therefore, sod planting is a high-quality option for weed phase management in orchards.

Keywords: Pomelo, ecosystem service, sod