One Step Towards Taming The Soil: Temperate Orchards

M.U. Rehman[1]*, Tashi Angmo[2] and Mehvish Hanief[3]

[1,2 & 3] Div. of Fruit Science, FoH, SKUAST-K Shalimar

Corresponding Author : munib11.mr@ gmail.com

Introduction

Realizing food security and agriculture sustainability is urgently required; therefore, improving many agronomic approaches, which have drastic effects on crop growth and yield are necessary. Among various practices followed by many farmers which need thorough thought, is the use of plough. Tillage is considered an essential tool for weeding, amendment incorporation and seedbed preparation prior to planting. However, associated with it, there can be long-term negative impacts on soil health as well due to mechanical disturbance, for which balance has to be established.

Orchards are unique among crop systems in their temporal and structural complexity. During the 15 to 50 year production cycles of perennial fruit plantings, a diverse community of naturally growing "weeds" or planted groundcover species develops on the orchard floor. This groundcover vegetation can provide substantial benefits of soil conservation, nutrient cycling and habitat for desirable wildlife. However, without careful management it can also compete with trees for limiting nutrients, complicate orchard operations and harbor economic pests of fruit. Sustainable orchard floor management systems require knowledge about site-specific conditions, plant function, and consideration of trade-offs among beneficial and detrimental aspects of groundcover vegetation.

Tillage

Tilling destroys soil's natural structure, breaking-up colloids and collapsing macro pores. The short-term result is a warmer, aerated and competition-free environment suited to seed germination. Yet, the fine particles and small pores characteristic of tilled soil are ultimately unstable, leaving fields vulnerable to erosion and compaction over time. Tillage can also alter soil ecosystems. Decomposition rates often increase behind the plow, hastening the breakdown of soil organic matter and subsequent release of carbon dioxide into the atmosphere. Organic matter loss paired with the drying effect of tillage dramatically limits soil water holding capacity and moisture available for plant growth.

The structure of soil under conventional tillage (left) degrades quickly when exposed to water: Soil under conservation tillage (right) forms stable aggregates that resist erosion.

No plant on the face of earth is so weak as to germinate only in plowed soil. Man has no need to plow and turn the earth, for microorganisms and small animals act as nature's tillers. Let the grasses plow the top

soil and the trees work the deeper layers. What can be more desirable to a farmer than being able to work the fields without pulling a plow or swinging a hoe? By killing the soils with plow and chemical fertilizers and rotting the roots through prolonged summer flooding, farmers create weak, diseased plants that require the nutritive boost of chemical fertilizers and the protection of pesticides.

Man has created the preconditions that give the things we never needed its value. Flood a field with the water, stir it up with a plow and the ground will set as hard as plaster. If the soil dies and hardens, then it must be plowed each year to soften it. All we are doing is creating the conditions that make plow useful, then rejoice at the utility of our tool.

Ploughed and Flooded orchards

Soil lives of its own accord

Good soil supports plant life and poor doesn't. Good soil is absolutely teeming with life. Most of the soil life (worms, slugs, centipedes, ants, ladybird beetle larva and more) is on the surface, in the first 4 inches. Great deal of the energy that results from photosynthesis in the leaves is actually used by the plants to produce chemicals they secrete through their roots. These secretions are known as exudates. Root exudates are in the form of carbohydrates (including sugars) and proteins. Amazingly, there presence wakes up, attracts and grows specific beneficial bacteria and fungi living in the soil that subsist on these exudates. Secretions and organic matter tend to make mineral soil components clump more and increase mean ped size and stability. The rootlets, hypha and other filaments form a mesh through the peds and hold the peds together.

'Moving' not 'tilling' would work

Groundcovers provide a renewable surface layer of biomass that protects soil from weathering and compaction and influences populations of beneficial and detrimental soil microorganisms. As this biomass decomposes into the mineral soil, it replenishes organic matter—promoting microbial activity, sustaining soil nutrient reserves and increasing soil pore volume and water-holding capacity.

Groundcovers growing between or within the tree rows can also be managed to help control tree vigor, enhancing fruit quality and tree winter hardiness. Excess soil nitrogen and water availability during late summer and early autumn can prolong shoot and canopy growth, delay fruit maturation, increase the potential for winter cold injury when woody tissues fail to harden-off sufficiently. In orchards where dropped fruit are gathered for processing or fermentation, it is especially important to minimize mud splashing and soiling of fruit beneath trees and grass or clover groundcovers are often maintained over the entire orchard floor.

Deciduous fruit trees in cool-climate regions remain dormant for almost half of the year and there is little uptake of essential nutrients from soil by dormant trees. The potential for soil erosion and leaching or runoff of nitrogen, phosphorus and pesticide residues is greatest during the dormant season. Cool-season grasses such as Festuca and Lolium Species and broadleaf groundcovers such as brassicas and legumes that continue growing when fruit trees are dormant, can serve as "green manure" that fix or retain nitrogen and

other essential nutrients in biomass residues during the winter months. Mowing of these groundcovers in late spring releases nutrient reserves at a time when they are readily assimilated by fruit trees.

Flowering groundcovers that provide habitat, pollen, and nectar food sources for predatory insects, such as hover flies (*Syrphidae*) and assassin bugs (*Reduviidae*), can increase populations of these beneficial insects in orchards and help to control leaf-feeding pests such as aphids and caterpillars, reducing the need for pesticides. Moreover, clover, a year round flowering legume, can feed the pollinators when there may be no other source of pollen or nectar left.

Permanent grass and broadleaf groundcovers also facilitate access by orchard customers, workers and machinery during wet/muddy or dry/dusty conditions. Properly managed groundcovers can improve soil fertility and water-holding capacity, provide habitat for beneficial wildlife, make orchards more attractive for workers and pick your-own customers, suppress pathogenic soil fungi and nematodes and limit excess vigor of mature bearing trees—optimizing fruit quality and reducing pruning costs.

Cherry Orchard with no ploughings

One of the most important ecosystem services for sustainable crop production is the mutualistic interaction between plants and animals: pollination. The international community has acknowledged the importance of a diversity of insect pollinators to support the increased demand for food brought about by predicted population increases. Insect pollination is threatened by several environmental and anthropogenic factors, and concern has been raised over a looming potential crisis. With the ploughing most of the soil nesting pollinators, their eggs get destroyed, which could otherwise have proven beneficial at the time of adverse weather conditions, when bees cannot work.

Conclusion

Weighing the pros and con of tillage, unnecessary tillage needs to be avoided. Orchards should draw a line between temporary and long lasting benefits while choosing any practice. Why to pay for the services which could otherwise be readily and naturally available as and where needed, like pollination services by soil nesting bees, vermi composting by the native worms in the orchard itself etc. This one step can lead in extended cultivable lands rather than degrading the existing ones.

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