

SOIL

EGX FIELD NOTES, AUGUST 2023



It starts and ends with soil; “from dust to dust”. You may have overheard discussions or headlines of the importance of soil.... it’s not just hype. Soils are one of the primary engines that drive life on earth. They are the most dense ecosystem on the planet, and it’s this ecosystem that allows so many other vital processes to take place. The crux of all these vital (and complex) processes is: Life above ground dies, feeding life below ground, which in turn enables and feeds new above ground life..... circle of life and all that. The rate of these processes is maintained at an equilibrium; not too fast, not too slow, which allows the inputs (decaying plants and animals), recyclers (fungi, bacteria, micro fauna), and products (soil nutrients and new life) to remain in balance.

When the soil is disturbed (tilling, plowing), this controlled rate of resource (re)cycling is thrown out of whack. Specifically, rather than soil microbes being fed organic litter gradually as it accumulates on the surface above, tillage mixes the microbes with their food, creating a microbial boom and bust, burning through organic matter at an accelerated rate, eventually leading to a crash of soil microbe populations. Additionally, the stable, spongy soil structure ideal for plants (resistant to erosion, able to soak up more water), is created and maintained by soil microbes. Tillage begins to destroy these soil qualities.

When you read about problems in agricultural productivity in Africa, one of the items at the top of the list is degraded soils. In most circumstances, farmers plow (with a jembe hoe, by hand) every year, the crops are grown (extracting soil nutrients), harvested, and the crop stocks and leaves are usually fed to animals or burned as fuel. The soils aren’t fertilized sufficiently to replace what the crop extracts, the leftover plant litter is removed from the cycle, leaving nothing to feed the soil microbes that drive the whole system; thus begets a powdery, dry, infertile soil, blowing or washing away, leaving a REALLY unproductive farm.

Last summer I was invited to advise a development organization in Rwanda. They’d had a growing burden to get involved in agricultural training and asked if I would take a look at their program. Some of their Rwandan staff had recently completed some training in conservation agriculture (farming methods to conserve soil and minimize chemical inputs). Ironically, just prior to receiving this training, they had plowed their fields to prepare for planting, only to learn on day one NOT to disturb the soil. Aside from that first hiccup, they were on the right track. Soil conservation methods are desperately needed in Rwanda particularly, “Land of a Thousand Hills”. Much of the country is on a steep slope, horribly vulnerable to soil erosion, yet the hillsides were checkered with plowed fields as I rode across the country (**See pictures below**). The soil conservation practices passed on by this organization to smallholder farmers, will preserve Rwanda’s hillside farms for future farmers. I was able to visit several of their sites,



encouraging them to press forward, while having some more in depth conversations about the soil dynamics enabled by reduced tillage.

In February I visited a group in Kenya. They too had been demonstrating and promoting soil conservation practices, and having good outcomes. Soil moisture retention was the clear benefit of soil conservation practices in this scenario. Kenya has been in a drought for the last several years, and farms with better soil management are seeing the benefits of what little moisture there is, going further for their crops.

Unfortunately, good soil management doesn't fix everything. I was taken to several sites with unknown maladies. The first was a yellow bean field with small plants, and light green to yellow leaves at the top of the plants. Kind of a classic nitrogen deficiency symptom at first glance, but it's always best to pull up a couple plants and look close. The stems looked damaged right at the soil line, and after a little plant dissection, the true culprit was found. A very tiny maggot (fly larvae), eating its way up and down the stem (**See pictures below**). After a little research, and some consultation with folks at ICIPE (the International Center of Insect Physiology and Ecology, conveniently located in Nairobi), Bean fly (*Ophiomyia phaseoli*) is a likely suspect. There are a few things farmers can do to mitigate damage from this insect, including proper planting dates and using bean varieties which have been bred for resistance to the Bean fly. We're still working on whether resistant bean seed is available.

The other main issue I was shown was damage to watermelon. The melons had what I can best describe as a belly-button. Farmers described seeing an insect around the flower, then as the fruit develops, a small concave spot forms with a black lesion in the bottom. They described the same phenomenon on their tomatoes. Buyers then reject any fruit with this "belly-button", because there is almost definitely a rotten core within. Farmers described some insect later emerging from the spot, and many of the watermelons had an open lesion with rot forming from the spot on the inside. I asked our group to search the field for a watermelon with the lesion still intact, without an open hole in the bottom. We found one, and I started slicing it open.....another maggot (**See pictures**). Probably Melon fly (*Zeugodacus cucurbitae*), but we weren't able to get a specimen back to ICIPE to confirm. There are some resistant varieties in development, and some pheromone traps that could help. Again, it's an issue of sourcing them.

From soils to insects, there are great people working on smart solutions that will benefit smallholder farmers. We just have to find them and find ways to get their work to farmers. Through on-the-ground organizations and ministries like these I visited in Rwanda and Kenya, we can bring some genuine hope and good news to farmers looking for answers.

Dr. Nathan Fortner

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Amazing vistas in Rwanda.



Farms are terribly vulnerable to erosion on steep hillsides.



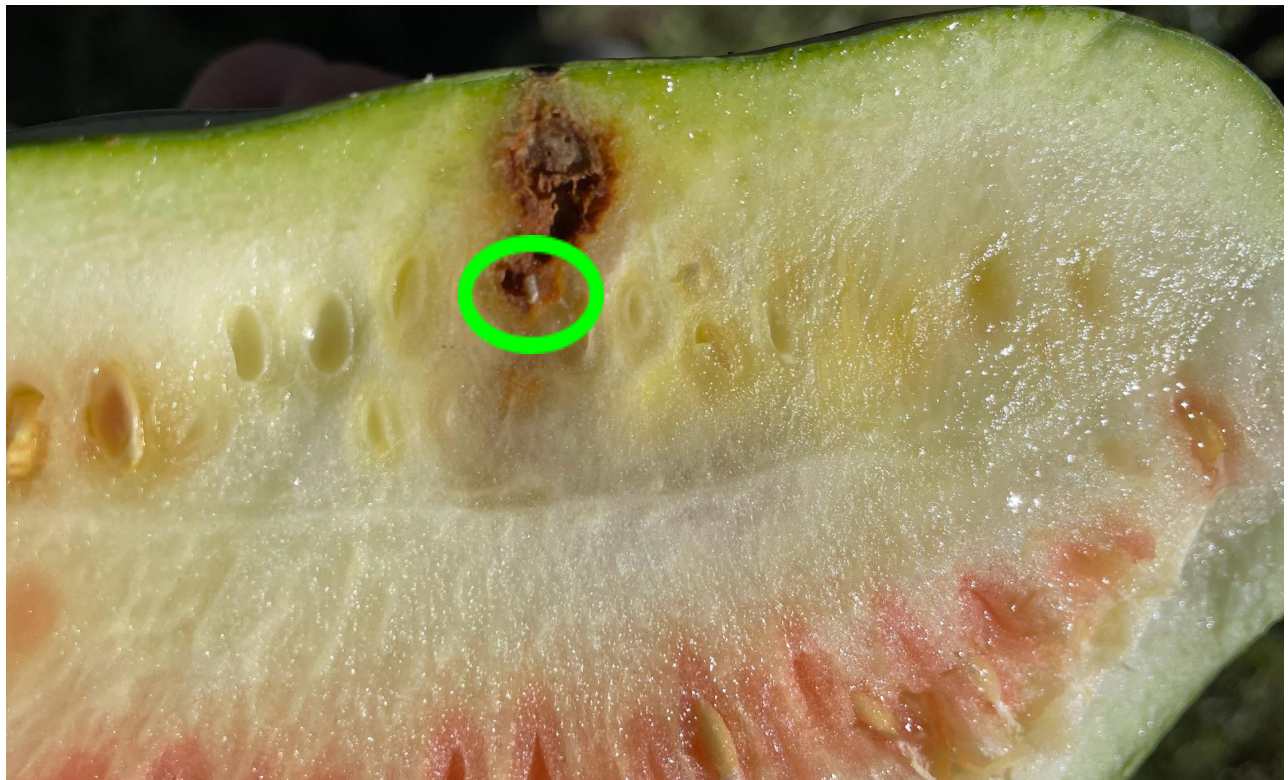
Homesteads cut into the Rwandan hillsides.



Bean fly larva and pupa in yellow beans on a farm east of Nairobi, Kenya.



Mellon fly mucking up watermelon on another farm in Kenya.



The end result.

