Assessing soil health indicators in an organically managed grassland

Pommeresche, R. [1]; Hansdotter, S. [1]; Rittl, T. F.[1]

[1]Norwegian Centre for Organic Agriculture (NORSØK)

Dairy farm

Farmers and advisors seek simple methods to monitor and discuss soil health. Here, we assessed the performance of different tests as indicators for soil health in a milk farm in Norway. The farm has around 25 milking cows and mostly clover grass ley in the crop rotation (Fig. 1). The farm has been managed organically since 1989, so the soil nutrient supply is manure from the farms herd, biological nitrogen fixation and liming.

Fig.1. *Grass clover leys with two harvests, followed by grazing, receiving slurry twice a year (left). Heifers grazing and manuring the permanent pasture on the farm (right).*

Materials and Methods

The soil health tests were implemented on four different fields. Three cultivated clover grass fields (GC), 2 and 4 years, and one permanent pasture (Pasture). Tests comprised of: soil organic matter (SOM) concentration (Ignition loss), labile soil carbon fraction (Active C), soil biology (Microbial C, springtail and mite), soil biological activity (soil respiration and feeding activity) and soil fertility (P-AL and K-AL) (Fig.2). Samples were taken from the topsoil (0-10 cm).

To be able to visualize and interpret the results of the soil health indicators together, we normalized data by calculating the response ratio. **RR = Xvalues/ Xmax**, where Xvalues represents the parameter's value measured and Xmax represents the maximum value measured for the parameter in the farm.

Fig.2. *All tests were done within and from soil close to a frame of 1m x1 m, in three places at each field. Five bait lamina stick, for measuring feeding activity, were placed in the middle of the "frame area".*

Results from soil health indicators

Overall, the permanent pasture had somewhat better soil health, based on higher values for a higher numbers of the selected soil health indicators, than the grass-clover leys (Fig.3). To visualize the results from several indicators together in a participatory manner, we normalised the data for each soil indicator. By doing so, we obtained an overall "soil health diagram" that farmers and advisors can interpret and use in the discussion of soil health (Fig.3).

Legend:
- GC_2
- GC_2
- GC_4
- Pasture

Axes: Springtail, Feed. activity, Soil resp., Microbial C, Mite, SOM, Activ C, pH, P-AL, K-AL

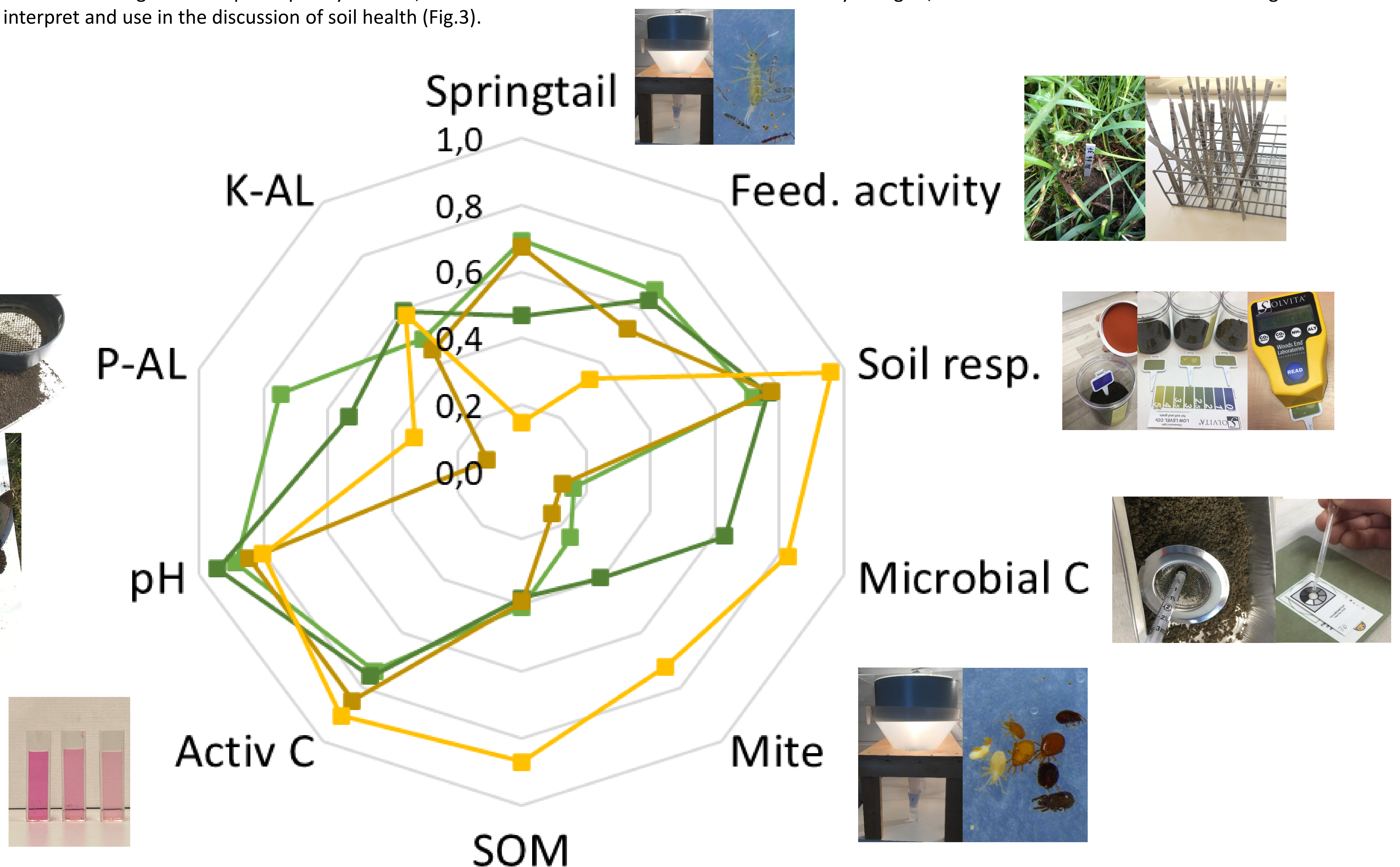Scale: 0,0 0,2 0,4 0,6 0,8 1,0

Fig.3. *Normalised results of several indicators for soil health from four different fields. Values of the indicators are interpreted as "better" the longer out from centrum the values falls. The results are given as mean, from 0 to 1, within each field and for each indicator, as relative to the highest measured value (=1) in the dataset from all the four fields (= normalised data). Around you see some photos of the tests and methods.*

Conclusions

Assessment and graphic visualization of several indicators and fields altogether seems useful in the discussion about soil health on farm level. Depending on the purpose of the assessment, a visual evaluation of the topsoil by digging and discussing in field is recommended to complement the selected indicators. More field data is needed to obtain "reference levels" for interpretation of soil health, and for a better understanding of optimal or low values of soil health indicators between cropping systems and management.