Allegato 1

DOMANDE ORALE – 22 SET 2020

1 - Gestione sostenibile della meccanizzazione per le colture arboree

2 - Sistemazione idraulica agraria principale e secondaria in collina

3 – Gestione delle reti dei fossi

4 - Miglioramento delle tecniche di gestione del terreno nelle colture erbacee

5 - Implementazione di un maggiore livello di biodiversità nelle aziende agricole con prevalenti colture arboree

6- Utilizzo di fertilizzanti organici

7- Messa a punto della gestione del sottofila nei frutteti

Allegato 7

PROVA DI INFORMATICA

1. Impostare una richiesta di preventivo per acquisto di macchine per la gestione dell'inerbimento di un frutteto.

2. Impostare una richiesta di preventivo di attrezzature e DPI per un cantiere di potatura dell'olivo composto da 2 operatori.

3. Prova parcellare di campo di confronto varietale di grano duro con almeno 3 ripetizioni. Disegnare con una tabella la mappa di campo.

4. Impostare una prova di gestione di terreno con confronto fra aratura, minima lavorazione e non lavorazione. Disegnare lo schema di campo.

5. Rendicontare sinteticamente la produzione media di ogni varietà e la produzione media totale di Grano duro convenzionale ottenuta nell'annata agraria 2019-20 di 3 differenti varietà:

- Campo 1 – superficie ha 8 varietà S. Carlo produzione q 420
- Campo 3 – superficie ha 11 varietà Achille produzione q 600
- Campo 4 - superficie ha 5 varietà Aureo produzione q 194

6. Preparare lo schema di ricetta per un trattamento primaverile di difesa fitosanitaria della vite a base di rame e zolfo.

7. Disegnare un piano colturale pluriennale per le colture erbacee con adeguate rotazioni e sostenibile dal punto di vista tecnico-economico ed ambientale.

ALLEGATO 3

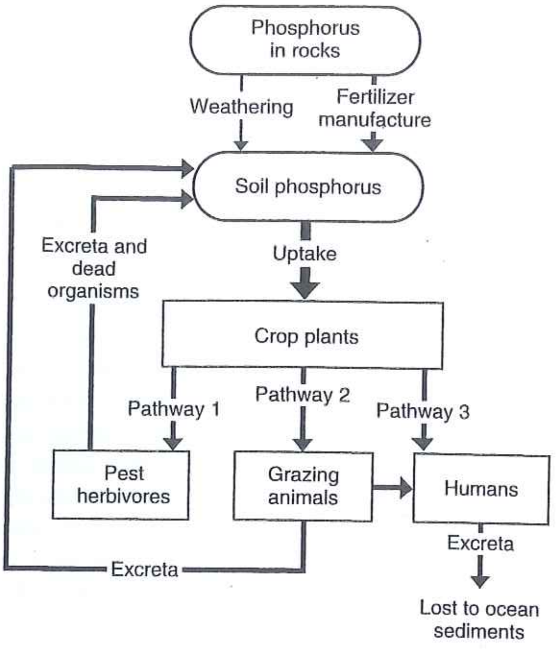

FIGURE 8.4 Pathways of phosphorus cycling in agroecosystems.

parent material; therefore, the input of phosphorus into the soil and the phosphorus cycle in agroecosystems is limited by the relatively slow rate of this geologic process.

Inorganic soluble phosphate ions are absorbed by plant roots and incorporated into plant biomass. The phosphorus in this biomass can be sent along one of three different pathways, depending on how the biomass is consumed. As shown in Figure 8.4, consumption of plant biomass by pest herbivores, by grazing animals, or by humans who harvest the biomass comprises the three pathways. Phosphorus in the first pathway is returned to the soil as excreta, where it decomposes and enters the soil solution. Phosphorus in the second pathway can be recycled in the same way, but if the grazing animal goes to market, some phosphorus goes with it. In the third pathway, there is little chance of the phosphorus returning to the soil from which it was extracted (except in much of China, where human excreta is used as fertilizer).

Much of the phosphorus consumed by humans in the form of plant biomass or the flesh of grazing animals is essentially lost from the system. An example of what may happen to phosphorus in the third (human consumption) pathway may serve to illustrate the problem: phosphate is mined from phosphate-rich marine deposits that have been geologically uplifted and exposed in Florida, processed into soluble fertilizer or crushed into rock powder, and shipped to farms in Iowa where it is applied to the soil for the production of soybeans. A part of the phosphorus, in the form of phosphates, is taken up by the plant and sequestered in the beans that are harvested and sent to California, where they are turned into tofu. Following consumption of the tofu, most of the liberated phosphate finds its way into local sewer systems, and eventually ends up returning to the sea 3000 mi from where it originated. Since the time necessary to build up sufficient sediments of phosphate-rich rock and to go through the geological process of uplifting is very much beyond the realm of the human time frame, and since the known easily-available phosphate reserves are quite limited, current practices of phosphate fertilizer management in many modern agroecosystems can be said to be unsustainable.

For sustainable management of phosphorus to occur, phosphate needs to pass quickly through the soil component of the cycle and back to plants for it not to be fixed in sediments or washed to sea. Ways must be found to better keep phosphorus in an organic form, either in standing biomass or in soil organic matter, and to ensure that as soon as phosphorus is liberated from this organic form, it is quickly reabsorbed by soil microorganisms or plant roots.

An additional component of sustainable management of soil phosphorus has to do with the formation of insoluble phosphorus compounds in the soil. Phosphates in the soil solution often react chemically (especially with iron and aluminum) to form insoluble compounds, or become trapped in clay micelles out of reach of most biological recovery. Low pH in the soil exacerbates the problem of phosphate fixation in an insoluble form. At the same time, however, these processes provide a strong mechanism for retaining phosphorus in the soils of the agroecosystem; phosphate fertilizers added to the soil are retained almost completely. Some agricultural soils in California show very high levels of total (through not easily available) phosphorus after several decades of farming. So leakage of phosphorus from agroecosystems can be quite small, but the unavailability of phosphorus from the soil component of the system once it is fixed requires further addition of available phosphorus in the form of fertilizer. Of course, biological means of liberating this "stored" phosphorus might contribute better to sustainability. These means have a lot to do with the management of soil organic matter.

SOIL ORGANIC MATTER

In natural ecosystems, the organic matter content of the A horizon can range up to 15 or 20% or more, but in most soils it averages 1 to 5%. In the absence of human intervention, organic matter content of the soil depends mostly on climate and vegetative cover; generally, more organic matter is found under the conditions of cool and moist climates. We also know that there is a very close correlation between the amount of organic matter in the soil and both carbon and nitrogen content. A close estimate of soil organic matter content can be obtained by either multiplying total carbon content by 2 or total nitrogen content by 20. 1

Soil organic matter is comprised of diverse, heterogeneous components. Its living material includes roots, microorganisms, and soil fauna; its nonliving material includes surface litter, dead roots, microbial metabolites, and humic substances (humus). The nonliving component is by far the greater proportion.

Interaction between the living and nonliving organic matter is constant. The complex carbon compounds in fresh plant litter are rapidly metabolized or decomposed, undergoing a process known as humification that eventually imparts a darker color to the soil as it produces humic residues, or humus. Humic residues consist of condensed aromatic polymers that are normally relatively resistant to further breakdown, and normally are capable of becoming stabilized in soil. The organic matter fraction that becomes stabilized, though, eventually undergoes mineralization, releasing mineral nutrients that can be taken up by plant roots. An equilibrium is reached between humification and mineralization, but this equilibrium is subject to shifts depending on farming practices.

During its life in the soil, organic matter plays many very important roles, all of which are of importance to sustainable agriculture (Magdoff and Weil, 2004). Apart from providing the more obvious source of nutrients for plant growth, organic matter builds, promotes, protects, and maintains the soil ecosystem. As we have already discussed, soil organic matter is a key component of good soil structure, increases water and nutrient retention, is the food source for soil microorganisms, and provides important mechanical protection of the soil surface. Depending on the cropping practices used, however, these traits can be rapidly altered — for the better as well as for the worse. Of all of the characteristics of soil, the factor that we can manipulate the most is soil organic matter.

Once a soil is put under cultivation, the original organic matter levels begin to decline unless specific steps are taken to maintain them. After an initial rapid decline, the drop slows. Several kinds of changes occur in the soil as a consequence of the loss of organic matter. Crumb structure is lost, bulk density begins to rise, soil porosity suffers, and biological activity declines. Soil compaction and the development of a hardened soil layer at the average depth of cultivation, called a plow pan, can become problems as well.

The extent to which organic content declines in soil under cultivation is dependent on the crop and cropping practices. Some examples follow.

In one study, the organic matter content of the upper 25 cm of soil in two agroecosystems used for intensive vegetable production in coastal central California were compared with each other and to an unfarmed grassland control. One system had been farmed for 25 years using organic farming practices; the other for 40 years under conventional practices. The study showed that the organic matter content had been reduced from 9.869 to 8.705 kg/m^3 in the organic system and to 9.088 kg/m^3 in the conventional system (Waldon, 1994). Even with the higher inputs of organic matter in the form of composts and winter cover crops in the organic system, cultivation and cropping significantly reduced soil organic matter even more than in the conventional system.

In another case, after 15 years of continual production of grains such as corn and rice, organic matter in the initial 15 cm of a heavy alluvial clay in the humid lowlands of tropical Tabasco, Mexico, had lowered to less than 2%, as compared to an organic matter content of more than 4% in an adjacent area of uncut tropical forest (Gliessman and Amador, 1980). A tree-covered cacao plantation on the same soil type was able to maintain the soil organic matter in the same layer at 3.5%, demonstrating the negative impact of soil disturbance on organic matter in cropping systems and the role of vegetative cover in retaining it.

A study comparing soils after 75 years of organic and conventional wheat production in eastern Washington found that organic matter was not only maintained in the organic system, but also actually increased over time, while production levels for the organic farmer were near equal to the conventional (Reganold et al., 1987). We can see from these three examples that crop type, input management, local environment, and cultivation practices all help determine the long-term impacts of farming on soil organic matter.

SOIL MANAGEMENT

In present-day farming systems, soil is treated as if it were mainly a medium for holding the plant up. When soil is managed for sustainable production and emphasis is placed on the role of soil organic matter, however, the role of soil is greatly expanded. 2

Many farmers feel that if a high yield is obtained from the land, then this is evidence of a productive soil. However, if the perspective is agroecological and the goal is to maintain and promote all of the soil-forming and soil-protecting processes involving organic matter, then a productive soil is not necessarily a fertile soil. The processes in the soil that enable us to produce a crop take on greater importance in sustainable agriculture. Fertilizers can be added to raise production, but only through an understanding of nutrient cycles and soil ecological processes — especially soil organic matter dynamics — can soil fertility be maintained or restored.

MANAGEMENT OF SOIL ORGANIC MATTER

The first step in developing soil organic matter is to maintain constant inputs of new organic matter to replace that, which is lost through harvest and decomposition. If the agroecosystem were more similar to a natural ecosystem, a diversity of plant species would be present in addition to the crop or crops being grown for harvest. Many agroforestry systems (Chapter 17), especially in tropical agriculture, have a large number of plants, many of them 3 noncrop species, whose primary role is biomass production and the return of organic matter to the soil. But present-day agriculture, with its focus on the market, has reduced plant diversity so greatly that very little organic matter is returned to the soil.

Crop Residue

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An important source of organic matter is crop residue. Many farmers are experimenting with better ways of returning to the soil the parts of the crop that are not destined for human or animal use. A major concern has been how to deal with potential pest or disease organisms that residue may harbor and pass on to a subsequent crop. Proper timing of incorporation of the residue into the soil, rotating crops, and composting the residue away from the field and then returning the finished compost are possible ways of overcoming this problem. Research on these and other management strategies are helping transform crop residue from a problematic by-product into a valuable part of soil organic matter management (Franzluebbers, 2004) (Figure 8.5).

Cover Crops

5

Cover cropping, where a plant cover is grown specifically to produce plant matter for incorporation, as a "green manure" into the soil, is another important source of organic matter. Cover crop plants are usually grown in rotation with a crop or during a time of the year that the crop can't be grown. When legumes are used as cover crops, either alone or in combination with nonlegume species, the quality of the biomass can be greatly improved. The resultant biomass can be incorporated into the soil, or left on the surface as a protective mulch until it decomposes.

In research done at UC Santa Cruz (Gliessman, 1987), a local variety of fava bean called bellbean (*Vicia faba*) was grown as a cover crop in combination with either cerealrye or barley during the winter wet season fallow period. It was shown that the total dry matter produced in the grass/legume mixtures was almost double that of the legume alone. After 3 years of cover crop use, organic matter levels in soils under mixed covers improved as much as 8.8%. Interestingly, soils under the legume-only cover actually dropped slightly in organic matter content

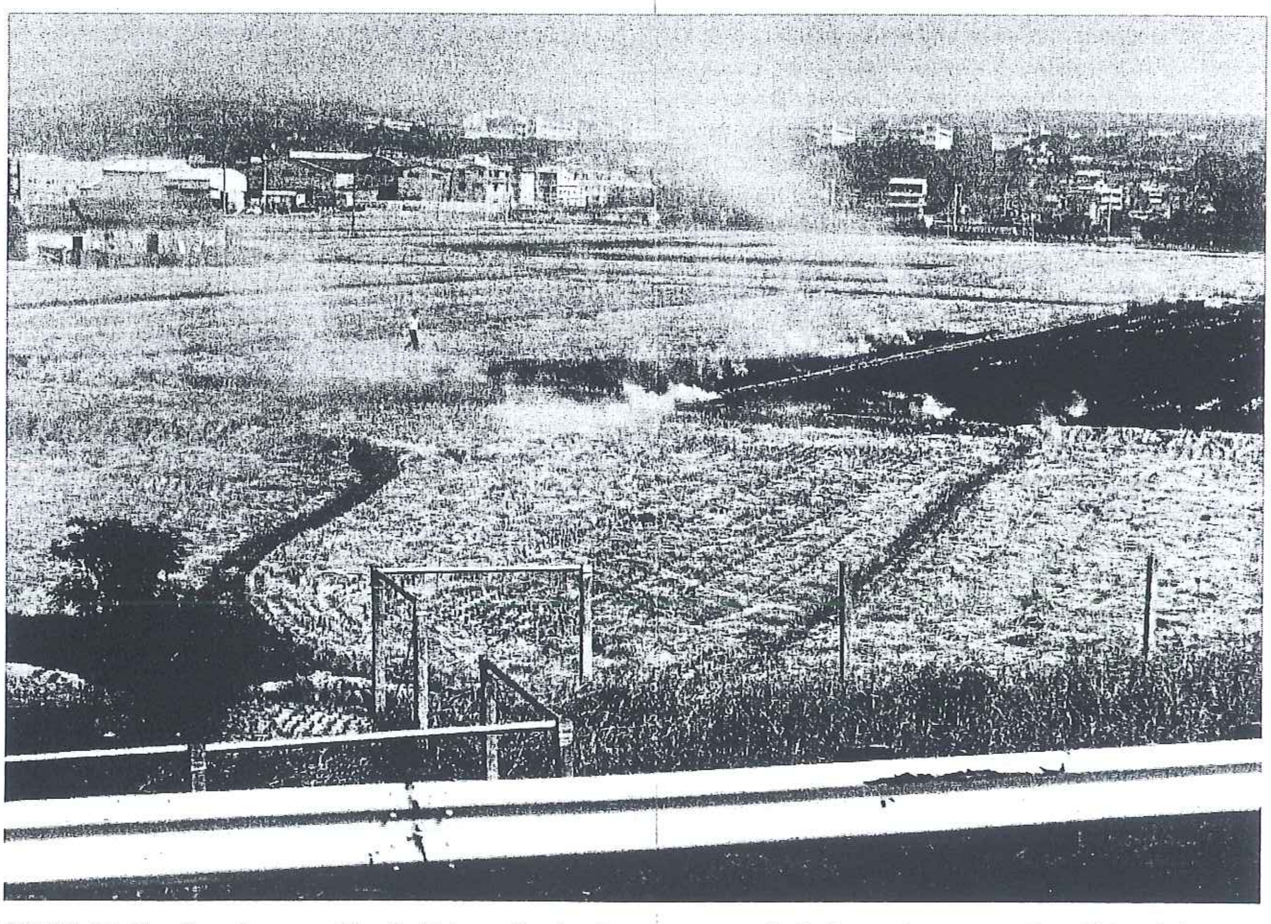

FIGURE 8.5 Burning of crop residue in Taiwan. Burning is a common method of removing crop residue. Although it returns some nutrients to the soil and helps control pests and diseases, burning can cause significant air pollution and prevents crop residue from being incorporated into the soil as organic matter. When crop residue is seen as a valuable and useful resource for maintaining soil organic matter, techniques for incorporating it into the soil can be developed as alternatives to burning.

Other Soil Amendments

A range of other types of organic soil amendments can be used as well. Humates, kelp, fishmeal, animal by-products, mined guano, and others are on the market. Each one has specific applications, advantages and disadvantages, and optimal scales of use. Each organic matter source needs to be examined for short-term crop response, but more importantly for possible long-term contributions to soil organic matter development and maintenance.

Sewage

A final source of organic matter — underutilized except in a few parts of the world — is sewage. To complete nutrient cycles, nutrients that leave the farm should ultimately come back to the farm. If they can come back in an organic form, then they will also add to the soil-building process.

Solid material removed from wastewater during treatment, known as sewage sludge, has been spread on the land for decades. As a percentage of dry weight, sewage sludge can contain 6 to 9% nitrogen, 3 to 7% phosphorus, and up to 1% potassium. It can be applied as dried cake or granules, with water content of 40 to 70%, or as a liquid slurry that is 80–90% water. Sewage sludge is widely used on turf grass, degraded rangeland, and even on the ground below fruit trees. The liquid portion of treated sewage, known as effluent, has been applied to land for a long time in Europe and selected sites in the U.S. Some cities operate, what are called, sewage farms where effluent is used to produce crops, usually animal feeds and forages, that partially offset the cost of disposal, where in other cases, it is used for irrigating golf courses, highway landscaping, and even forests.

There is much to learn, however, about how to treat sewage so that pathogens are dealt with properly. Collection, treatment, and transport all need to be examined with an eye toward the goal of linking waste management with sustainable agriculture. The fact that many sewage systems around the world do not separate human from industrial wastes, contaminating the resultant sludge with toxic amounts of heavy metals, complicates the process immensely.

Nevertheless, sewage will undoubtedly become a more important resource in the future as a source of organic matter, nutrients, and water for crop production. Many small-scale and traditional practices for turning sewage into a useful resource can serve as an important basis for future research on this important link to sustainability.

TILLAGE SYSTEMS

The conventional wisdom in agriculture is that soil must be cultivated to control weeds, incorporate organic matter, and allow root growth. Despite its potential benefits, however, cultivation can degrade soil structure and organic matter content, and cause the soil to lose some of the elements of productivity. For this reason, paying attention to how the soil is cultivated must be an integral part of soil organic matter management.

6

Many different patterns of soil tillage exist, but the main pattern employed in conventional agriculture is a three-stage process involving a deep plowing that turns the soil, a secondary tilling for preparation of a seed bed, and finally postplanting cultivations (often combined with herbicide use) for controlling weeds. Soil erosion, loss of good soil structure, and nutrient leaching are well-known problems associated with this pattern of tillage. Despite these problems, most conventional farming systems, especially those producing annual grains and vegetables, are dependent on extensive and repeated tillage.

At the other extreme, there are many traditional farming systems in which no tillage is used at all. In swidden agriculture, traditional farmers clear land using slash and burn techniques and then poke the soil with a planting stick to sow seeds. Such systems, which have the longest history of sustained management, respect the need for a fallow period to control weedy vegetation and to allow natural soil building processes to replace removed nutrients. Many agroforestry systems, such as coffee or cacao under shade, depend on the tree component of the system to provide soil cover and nutrient cycling, and only receive occasional surface weeding. Permanent pasture is rarely cultivated either.

Alternative tillage techniques, many of them borrowed from traditional farming practices, have been developed for and tested in conventional annual crop systems. These have demonstrated that annual crop systems do not have to remain dependent on extensive and repeated tillage and that reduced tillage can help improve soil quality and fertility (Franzluebbers, 2004).

Using the technique of *zero tillage*, soil cultivation is limited to the actual seedbed and is done at the time of seed planting. In some cases, special equipment is used that allows planting directly into the crop residue left from the previous crop. Other steps, such as fertilization and weed control, can be completed at the same time as planting. Unfortunately, many zero tillage systems have developed a great dependence on herbicides, which may create other ecological problems.

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In order to reduce herbicide use, a number of *reduced tillage* systems have been developed. One in particular that has been quite successful for corn and soybean production is *ridge tillage*. After an initial plowing and formation of planting beds or ridges, the only cultivation that occurs is seed planting and weed management with specially designed tillers that cultivate the surface of the soil only. Some ridge till systems can go through many years of repeated planting without deep tillage, and the reduced soil disturbance helps preserve soil organic matter and structure. The Thompson Farm in Boone County, Iowa,