

TSP

Teacher Scientist Partnership

TSP activity:

“Conservative sustainable agriculture as a tool to mitigate greenhouse effect”

Topic: CO₂ and agriculture

Country: Italy

Partner: Fondazione per il Clima e la Sostenibilità (FCS)

Schools involved in the activity:

Istituto di Istruzione Superiore (IIS) “Alberti”

Istituto Professionale di Stato per l’Agricoltura e l’Ambiente (IPSAA) “Vetrone”

Area: Campania region; Benevento province

General introduction

Benevento province is a mid-southern Appennine area



situated in the north-eastern part of Campania region; 150km far from Naples and 250km far from Rome.

The area is mostly characterized by hills and mountains, seldom

higher than 1000 m usl. Agriculture is the main human activity, with a big number of little family-farms that cultivate an high percentage of the area. For centuries, traditional agriculture has been



contributing to the management this articulated territory. Modern “intensive” agriculture, on the contrary, has exposed in the last decades the agrarian soils to a real over-use, with the consequence of problems of erosion, landslides and strong organic matter losses.

Topic introduction

Modern intensive agriculture can strongly contribute to increase CO₂ emissions, especially if not well practised. Emissions are originated directly and indirectly by agriculture and quite always are higher than the CO₂ taken up by the photosynthesis. Tractors burn gasoil and fertilizers are produced using petrol, and this contribute to direct emissions especially when people use deep tillages to prepare the soil and big quantities of fertilizers. Soil Organic Matter (O.M.) is an important element of the fertility. It contributes to the soil



structure, provides minerals and conserve humidity. Soil O.M. is composed by the plant rests (leaves, roots, parts of the harvest...); it results from the photosynthesis and so it is composed mainly by carbon. Before of the modern agriculture, at the beginning of the 20th century, agrarian soils were composed, for more than 5-7% by, Organic Matter. Modern intensive agriculture, especially in

marginal conditions (slopes, mountains, heavy soils...), has determined a huge oxydation of this soil O.M., with the result of big emissions of CO₂ (millions of tons/year in the world) (still in progress) and the consequence of strong reduction in soil fertility.

Conservative agriculture, reducing inputs, can contribute to reduce agrarian CO₂ emissions directly (less gasoil, less fertilizers) and indirectly (supporting the storage of CO₂ in the soils in the form of O.M.).

Conservative agriculture: the sod seeding system

Sod Seeding (S.S.) is a conservative way to cultivate cereals and erbaceous corps. It's widely used in south America (from more than 20 years) and, from few time, in some regions of Europe too.



SodSeeding., also named *Direct Seeding* or *No tillage* is a technique that doesn't need any kind of preparing soil tillages. It's carried out with a special machine that, with a special system of disks, opens on closes in the soils thin furrows in which seeds go placed. It can be used on soils just after the cereal harvest, directly on grasslands or on

“set aside” soils. Literature data, show that this thecnique, if applied in a sustainable way, can substitute traditional modern agriculture, with good productions (comparable to the traditional ones) and interesting soil fility betterments in the years. Together with a rational and/or dedicated management of cultivation residues, actually, SodSeeding system can contribute to increase soil O.M. content, with good results in terms of soil



structure and mineral composition. Erosion and landslides risks (especially in slope agriculture) can result reduced such as **CO₂ emissions**.



Avoiding soil tillages, actually, this technique reduces soil O.M. oxydation (that's the cause of strong CO₂ emissions) and contribute its storage in the soils. This way, agrarian soils have the potentiality to change from CO₂ "sources" to CO₂ "sinks", also in

consideration of the low energy inputs used for the whole production cycle. And this can also have considerable large-scale effects, considernig the huge world agrarian surfaces. If (theoretically) the 186 million Ha of the USA agrarian land would be put under SodSeeding technique, 4.3 mln of tons of CO₂ emission would be avoided every year (Frye, 1984).

Moreover SodSeeding tecnique is suitable for farmers because improves production efficiency, reduces times and, in the long period, also the need in fertilizers.



TSP activity:

"Conservative sustainable agriculture as a tool to mitigate greenhouse effect"

Starting point

The starting point of the TSP planned activity is that SodSeeding technique (but in general conservative agriculture) can contribute to mitigate greenhouse effect getting positive or more positive the overall CO₂ cultivation balance. This looks like a good way to reduce environmental CO₂ emissions and also to remove from atmosphere, in the long-period, interesting quantity of CO₂.

These elements have been considered interesting for the students of two Benevento's technical secondary schools: *IPSAA "Vetrone"* and *IIS "Alberti"*.

Schools

- ***IPSAA "Vetrone"*** (State Professional School for Agriculture and Environment) is a five-years technical secondary school. At the age of eighteen, at the end of this school, students get a "professional degree", important and usefull for the employment,



especially in a rural province as Benevento. The main aim of the school is to provide knowledges about agriculture and environment and to prepare technicians ready to deal with the future developements of agro-environmental matters. This is why relationships beetween agriculture and greenhouse effect have been considered an

important theme to be studied in TSP activities. *IPSAA* has got a farm of its own of more than 7 hectareas of vineyards and olives cultivated in biological way. Other 5 hectareas are dedicated to experimental activities with greenhouses, variety tests of cherry, germoplasm conservation and meteorology monitoring system. *IPSAA* has reserved a part of the fields to realize experimental proofs for TSP activities on which students could study crops and look at the effects of conservative agriculture. These fields, moreover, are the base for the experimental activities of *IIS "Alberti"* students.



- ***IIS "Alberti"*** (Superior Instruction Insitute) is a multiple instruction institute, with three different schools inside. Among these, "Chemistry-enviromental" school has been involved in TPS project togheter with *IPSAA* in the activities concerning conservative agriculture. *IIS's* Chemistry-enviromental is a five-year secondary technical school that



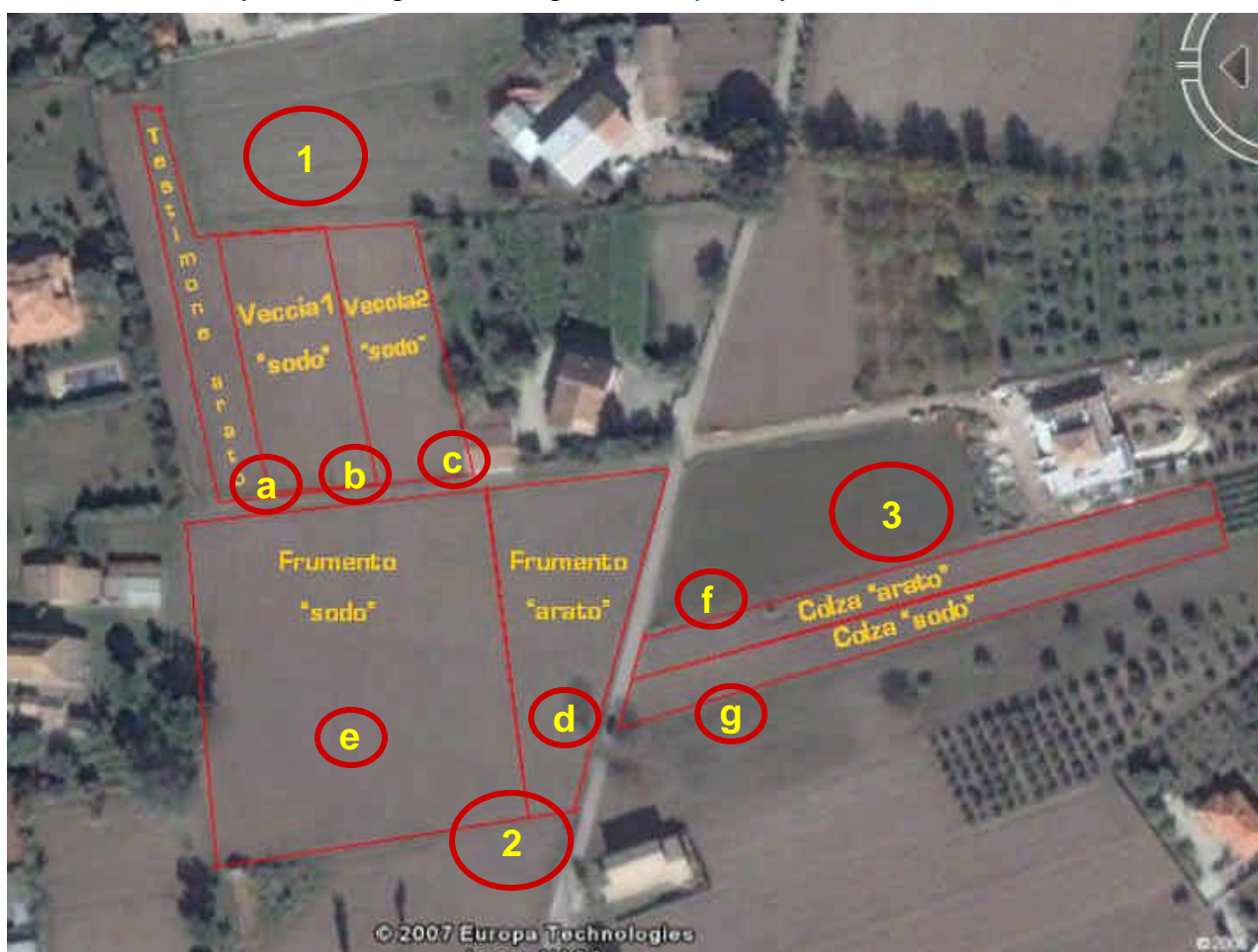
use to carry out different experimental activities (in partnership with the municipality of Benevento and with the Faculty of Environment of the University of Sannio) about urban pollution monitoring and rainfall. Students have good practice with the instruments for the analysis of the different atmosphere

parameters and are well prepared on urban and industrial pollution, included CO₂. Students, anyway, have few experience in agriculture and don't immagine that agriculture can contribute to increase greenhouse effect as a car or an industry can do. Neither they can immagine that agriculture can contribute to mitigate greenhouse

effect, or that the agriculture can be a field of application of their knowledges, and a work for the future. Chemistry-environmental school has been involved in TSP project within the activities concerning conservative agriculture. Together with IPSAA, actually, IIS students will carry out researches and analysis on the experimental fields prepared in the IPSAA's farm. These has been considered a good way to get IIS's students closer to agro-environmental aspects and greenhouse effect.

Experimental proofs

In the IPSAA farm have been prepared three simple experimental fields. The main aim of the activity is to observe the effect of the Sod Seeding technique in comparison with the "modern" (traditional) technique and to estimate the potential for greenhouse effect mitigation. IPSAA's students will be involved in analysis concerning agronomic aspects (crops growth, soil fertility, weeds...); on the other hand, IIS's students will carry out instrumental analysis of soil gas exchange, CO₂ especially.



The aim of **field 1** is to show which can be the best solution (in term of soil fertility and CO₂ balance) for the winter management of soils between the spring and the autumn cultivations. Field 1, actually, hosted wheat till July 2007. During autumn it is "resting",

waiting to host corn in april/may 2008. With traditional agriculture, farmers use to plough these kind of fields leaving it naked for all the winter (with big CO₂ emissions and strong erosions on slopes); and this is what has been done in the parcel “a”, prepared as reference. In the “b” and “c” parcel of field 1, has been seeded Vetch (*Vicia villosa*) (with sod seeding technique) as “intermediate” cover crop. *Vicia* is an herbaceous legume that, as many herbaceous legumes, has the capacity to increase soil fertility. With the sod seeding technique, it can represent a perfect “bed” for the seeding of corn in spring. Moreover, cover crop’s photosynthesis contribute to make soils “sinks” of CO₂. Actually, photosynthesis



CO₂ will be “imprisoned” in the soil as Organic Matter resulting from the humification of the crop rests.

Differences between the traditional and the sod seeding techniques will be studied. *IPSAA* students are analysing crop growth during the winter. In spring, they will follow the operation of corn seeding. In early autumn 2008 they will

analyse differences in corn production and soil fertility. *IIS* students, in the same time, are instrumentally analysing soil gas exchanges, with particular regard to CO₂ emissions, in comparison between the traditional and the conservative technique.

Field 2 has the aim to compare the behaviour of wheat (*Triticum*) under the traditional and sod seeding regimes. Parcel “d” has been prepared with the traditional method and will be fertilized in the traditional way in late winter and spring. Parcel “e”, the bigger one, has been seeded with sod seeding technique and will be fertilized in a different way. At the moment of late winter fertilization, actually, only on “sod seeding” parcel, fertilizer will be scattered mixed with zootechnic clover (*Trifolium*) seeds. Clover will grow up more slowly than wheat. In july, wheat will be harvested, straw will be scattered and let on the soil and clover will be ready forming a green and fertile grassland. Clover, actually, is a legume and its habit is to produce residues with high fertilizer qualities that, mixed with straw, will form high quantity of O.M. Clover won’t be harvested; in early autumn it will be cutted and let on the soil as “bed” for the seeding of a winter or of a soing crop. Students will analyse the 2 parcels. *IPSAA* students will follow agronomic aspects such as crop growth or weeds. *IIS* student will analyse the differences in soil gas exchanges, with particular regard to CO₂

emissions with the aim to show that using cover crops and conservative agriculture can contribute to reduce total process emissions.



Field 3 has the aim to compare the behaviour of Rape (*Brassica napus*) under the traditional and sod seeding regimes. Rape is a crop that is getting increasingly importance as biomass in the last few times. Colza seeds, acutually, have got 50% of oil good to be used as bio-fuel. Rape oil, moreover, can be easily trasformed in biodiesel (with a chemical process) ad used for vehicle locomotion too. Rape, furthermore, represent a good crop for cultural rotations with wheat. Agrarian biomasses can contribute to provide new “clean” energies but their production has to be sustainable and must have convenient CO₂ total balances. The aim of the

proof is to analyse the conservative production of rape in comparison with the traditional system and to estiamate if conservative agriculture can provide agrarian biomasses with a more convenient CO₂ total balance. As for the wheat, sod seeding rape will be fertilized in late winter also with seeds of clover. Clover, together with the many residues of rape (only seeds are harvested) will form fertile layer in which wheat or other crops could be seeded directly.

First acitvities carried out

TSP project has been showed to the director of the provincial office, dr. Mario Pedicini,



who was interested and allowed to proceed in school involving.

On 20th october 2007, on the fields located in *IPSAA* farm, a beginning day of the project has been displayed. Tractors seeded the crops at the presence of many students belonging to

IPSAA and *IIS* but also to other primary schools involved as partners in TSP. The meeting, actually, has been an occasion to crate the basis for a network between the schools and a moment to discuss about TSP contents and scenarios. During the “beginning day” *IIS*



students used for the first time on the soil their instruments and gave explanations to other students and to some farmers there present.

Theoretically notions about greenhouse effect have been given such as details about TSP and the *IPSAA* planned activity. The news



of the meeting has been published on one of the most important national technical review on agriculture and a special article about the activity will be published on a national review for work

machines.



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