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Reduced Tillage Problem in the New Conditions of Romanian Agriculture

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ABSTRACT

Research on reduced tillage either for winter or for spring cereals have been carried out in Romania for more than 30 years, but more intensively in the last 8 years, taking into account the new status of agriculture after the political changes of 1989. The specialists of INMA designed, built and tested several prototypes to be used in those technologies, using 65 and 100 HP tractors, the most common tractor size in the Romanian agriculture. Included in this study were a chisel plow, a grain drill with double disc openers, a 4 and 6 row no till planter and a ridge cultivator. With simple adaptations, the planter was changed for planting on ridges. Crop production was more efficient because of the reduction of fuel consumption, reduction of labor, similar yields and increased farmer productivity that allow the farmers to work more hectares in the short optimum period. There were benefits to the soil, mainly from protection against erosion, increased trafficability, soil aeration, and water infiltration and conservation. These results suggest opportunities for the extension in Romania of reduced tillage methods, in different versions.

INTRODUCTION

Situated in the central-south-eastern Europe, in an area with temperate-continental climate, topographically Romania resembles a huge amphitheater. In the center, the Carpathian Mountains, an extension of the Alpes Mountains lays like an arch. The lofty peaks of the Carpathians slope gently between hills and tablelands to large, flat and fertile plains that lay toward big rivers that flow into the Black Sea.

Benefiting from a rich soil and mild climate, not too dry because of the Black Sea and not too cold because of the mountains. The Carpathians stand like a wall against the winds from the North. Romania has had from its founding a strong tradition in agriculture. More recently, between the two world wars, Romania was considered the granary of Europe, but in the last 50 years, Romania lost its top position.

After the 1989 political changes, many changes have occurred in Romanian agriculture.

Over 80% of the land has been transferred from the state or co-operatives to the former owners or their heirs. People with reduced financial possibilities and little experience in farming after 50 years of being employed in other sectors of the economy are now engaged in farming. Now, more than 56% of the agricultural surface is farmed in small tracts.

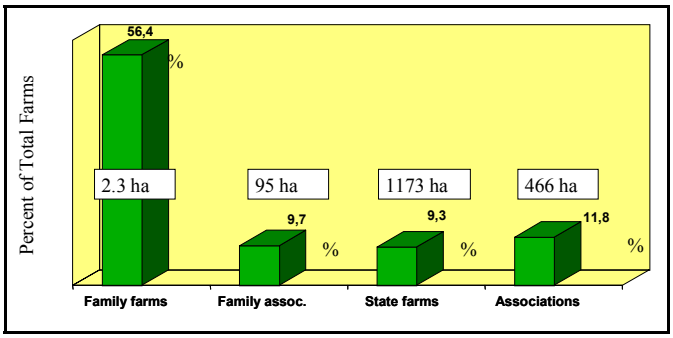

Figure 1.

The structure and the average size of farms are shown in the Figure 1. There is a process of association in progress, but after 50 years of forced association in co-operatives, with bad results for the owners, this process will take much time. Strong feelings over ride other possible considerations.

- The cancellation of state subsidies for agriculture and the intense competition as a result of the opening of international markets create difficult problems for farmers.
- In Romania arable land averages 0.41 ha / capita which is about two times the mean of Europe which is 0.24 ha / capita. In Romania, the manpower employed in agriculture is one of the highest in Europe. Of the working population 35.6% (four times the mean of Europe) are engaged in agriculture. In addition, 49.7% of the people involved in agriculture are over 60 years old, although the same age category in the total population of Romania represents only 15.9%. Figure 2 shows the arable land per capita in different European countries and the Figure 3 the percentage of the population involved in agriculture from the total active population in Europe. (Phare, 1998; Ahuarul statistic al Romaniei, 1996, 1997, 1998)

More than 75% of the tractors used in Romanian agriculture are 65 HP size. A smaller percentage are 100 HP (Phare, 1998).

These are rather small to be used with complex implements for single pass planting.

Long term experiments demonstrate that soil organic matter is continually diminished and the soil compaction is growing, although big heavy tractors and implements from abroad were not yet employed on a large scale. For example, in the last 50 years, in several areas of the Danube Plain the

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content of humus decreased from 5-6% to 1.9-2.2% (Teaci, 1998). The researchers put this situation in charge of the yearly deep plowing, non-controlled traffic, improper weed control, insufficient and incorrect applied fertilizers, all these as effects of the so-called "intensive agriculture" carried out in the former regime.

Other serious problems include drought in the last few years and the inability of many farmers to use the existing irrigation systems. These would be available on about 3 million hectares, but are not used because of the financial limitations (high cost of energy, non-maintained irrigation systems and equipment).

From the land cultivated for grain, about 3 million hectares are cultivated with maize and about 3 million hectares wheat, barley and other grain cereals, as shown in the Figure 4. About 50% of the wheat is sown after maize and other late maturity crops and there is not enough time to work conventionally in the optimum period (Ahuarul statistic al Romaniei, 1996, 1997, 1998).

As a consequence, farmers would like to reduce as much as possible the planting time and in the same time to reduce fuel consumption, spare parts and time for machine maintenance, but also soil erosion and compaction that could be obtained by using reduced or no-till technologies.

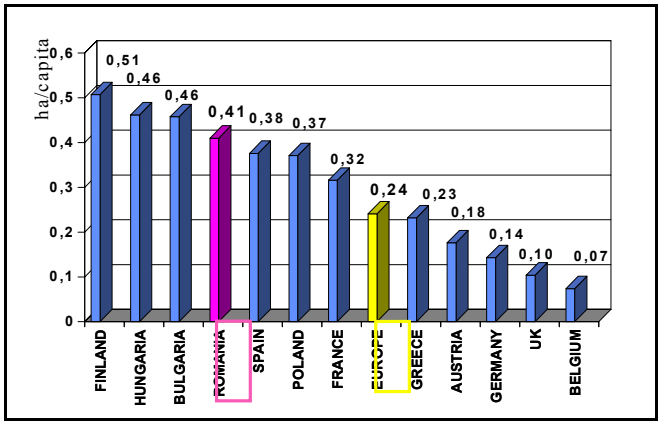

Figure 2. Arable land per capita in different European countries.

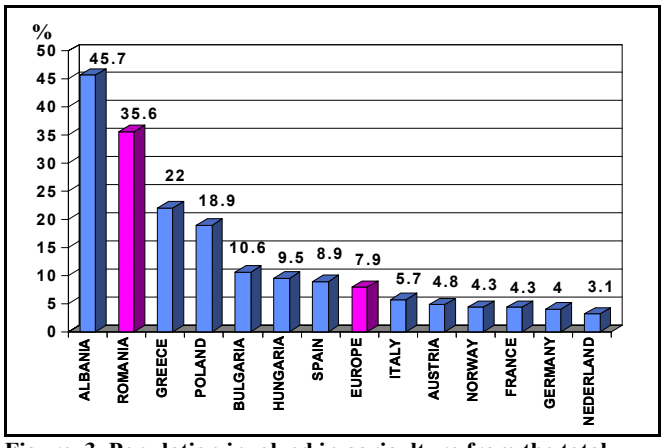

Figure 3. Population involved in agriculture from the total active population in Europe

Based on Romanian and international experience, research concerning minimum tillage have been conducted in Romania for more than 30 years at various research institutes and stations, both on flat and sloping fields.

The main objectives of this research were either economical (efficiency of crop production by reduction of fuel consumption, as well as of time) or ecological (reduction of soil erosion, soil and water conservation) and practical (solving the problem of a shortage of time when preceding crops are late or prolonged winters, rains, lack of equipment, the farmer is obliged to find other ways of farming.

Nevertheless, minimum tillage techniques are not widespread in Romania because of several reasons including lack of appropriate implements, not enough information available to farmers, the problems with weed and disease control and lingering after effects of the rules of the centralized economy of the former regime.

Several experimental models have been used to solve these problems and to set up sustainable alternatives for soil tillage and crop production according to the socio-economic

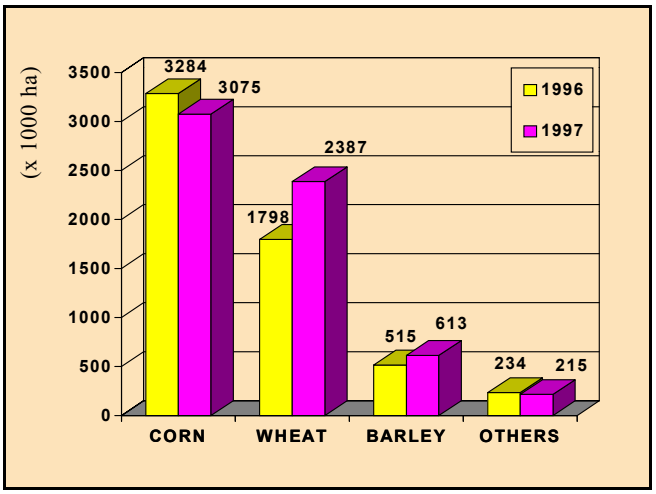

Figure 4. The area cultivated with the principal crops for grains.

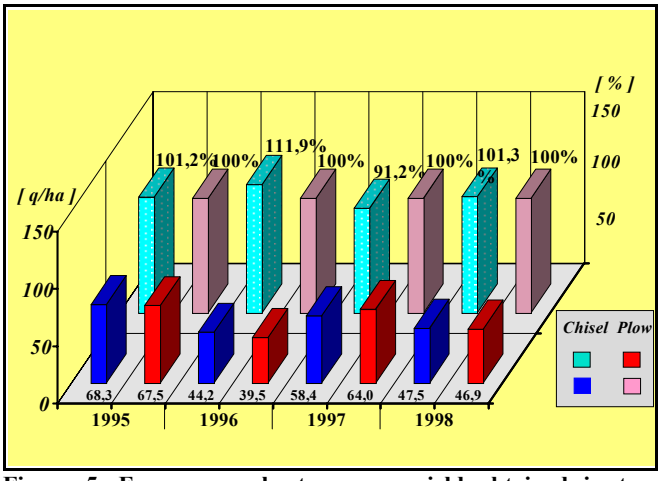

Figure 5. Four year wheat average yield obtained in two systems of soil tillage

status of the farmers, agricultural practice, crop diversity, soil and climate characteristics of different regions of Romania.

Despite a great number of farmers who do not conceive yet agriculture without moldboard plowing, it is an almost general practice to plant winter wheat after disking, because of shortage of time for conventional tillage and seed bed preparation after late preceding crops.

For the same reason, several implements for reduced tillage including a chisel plow and sowing with a grain drill equipped with double-disc openers was studied. These implements were designed for the 65 HP tractors. These studies were carried out on different categories of soil. The main features of the chisel plow are:

- number of shanks: 7
- working width, m: 2.25
- max. working depth, cm: 25
- active working point: chisel with two sweeps

The level of the production was similar (91.2 to 111.9%) to that obtained by conventional tillage. The fuel consumption was reduced to 56.3 % and the working productivity was 220% of that of the conventional technology (Figure 5; Cojocaru et al., 1997; Neacsu et al., 1997).

After 4 years experiments, we can conclude that moldboard plowing can be successfully replaced with chisel plowing. A large quantity of crop residue remains on the soil surface after working with the chisel. For best results from sowing with a grain drill equipped with disc openers, it is necessary that previous stalks be shredded and spread.

On the other hand, for a variety of reasons in spring can be a short optimal period for crop establishment.

The combinations of implements for reducing the traffic are widespread in America and in Europe are not applicable to Romania because the power of the average tractor cannot operate those big and heavy machines.

Using Romanian and international experience in reduced tillage, we have developed for the 65 - 100 HP Romanian tractors a 4 - 6 row no-till planter, a ridger cultivator and a machine for planting on ridges which is simply adapted from the no-till planter.

In all the experiments, made on Chernozem or Brown Red soil in three zones of the country, weeds were controlled by initially spraying with 2:l Gliphogan ha^{-1} in 200:l water and then, using the ridger cultivator.

While the fuel consumption with no-till was 43.2% of the conventional and 46% when planted on ridges. Time for these operations was reduced to 42.8-47.4% of the conventional. Ridges were specially created in late autumn, to solve the problem of not enough time for plowing. Taking into account that ridging is three times as fast as moldboard plowing and fuel consumption is 40%, planting in spring on those ridges, then fuel consumption and labor were reduced to 57.6%. Yields were between 90 and 103% of conventional. There was not significant difference in crop yield as compared to conventional when weeds were controlled (Figures 6, 7, 8 and 9; sp. = specially created, rem = remained from the previous crop; Neacsu et al., 1997).

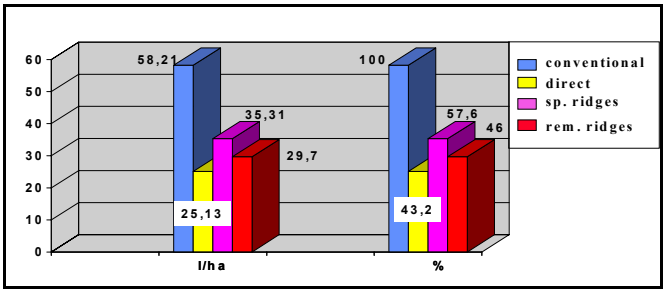

Figure 6. Fuel consumption in four different tillage systems.

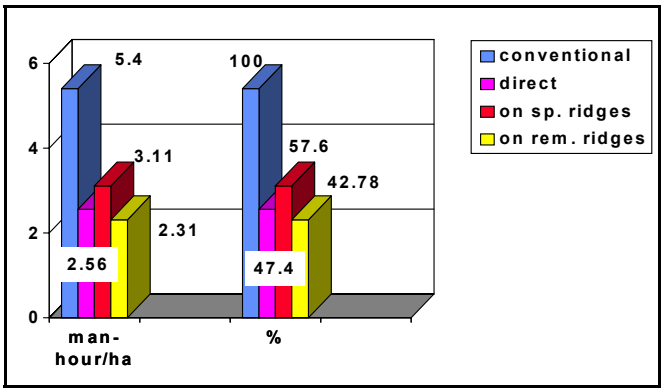

Figure7. Working time in four different tillage systems.

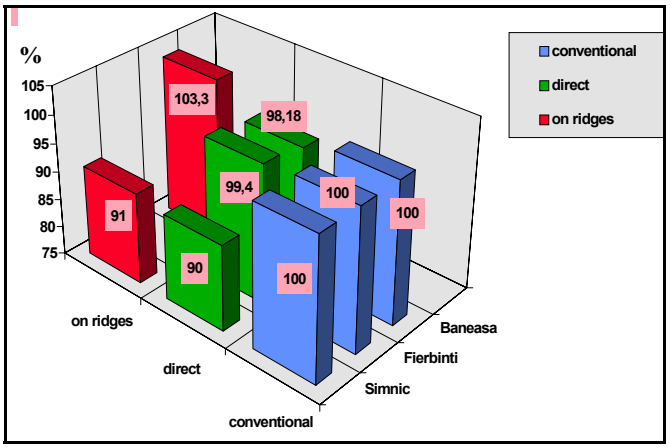

Figure 8. Corn yields obtained in three areas by three tillage systems.

The soil compaction was obviously reduced either as a consequence of limited traffic and low tire pressure or from natural processes and much more present and active fauna.

An important constraint for extending these technologies, in addition to the lack of machines, is weed control. This is due to due to their limited efficiency and high price of effective herbicides and the safety problems involved by their use. There are also concerns about their influence on the soil and plants from ecological point of view.

Crop rotation and a mix of tillage practices with soil loosening and moldboard plowing every 4-5 years and then reduced or no tillage seems to be a good way to proceed with further research.

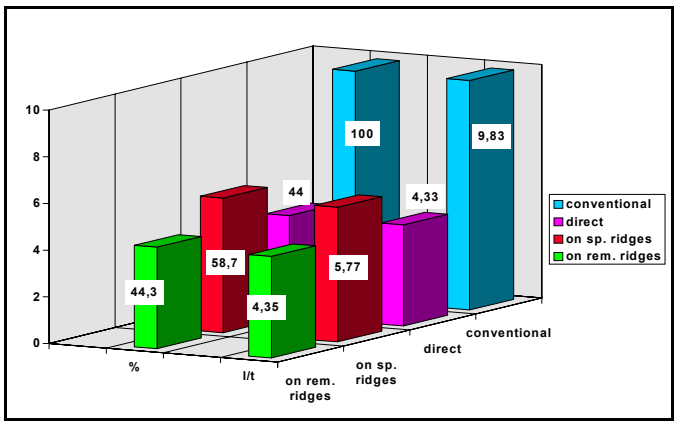

Figure 9. Specific yield per 1 tone of corn in three tillage systems.

CONCLUSIONS

The results of the tests carried out by Romanian researchers using implements designed and built for the 65-100 HP tractors, specific to Romanian conditions confirmed the data already available in the literature concerning the efficiency and the limits of reduced tillage.

The slightly lower efficiency as compared to tests carried out in various countries is most likely due to the performances of the tractor and to the specific conditions of soil, size of farms, and implements used.

The yield was at the same level considered normal for Romanian conditions.

The overall efficiency of the crop was higher than in conventional tillage, mainly because of the reduction of the fuel and manpower requirements.

From technical point of view the straw and other crop residues cause problems to the tillage and sowing implements, whose working parts have to be optimized, although a large choice of sowing techniques and herbicide options are available on the international market.

Reduced tillage is a complex problem and of a great importance for the farmer. Extensive information must be available to ease the switch from one to another technology.

A comprehensive range of technical, economic and ecological data is available in Romania concerning where reduced tillage is best adapted, with what kind of implements, the potential profit margins, crop rotation etc.

More work is needed to address ecological aspects and to find an efficient and cheaper way for weed control, to improve the working parts of the planters especially in fields with high quantity of crop residues and on medium and heavy soils.

Of great importance is the participation of researchers and farmers in meetings with researchers and farmers from different countries, to exchange ideas, to learn one from the other, to transfer information to other farmers and to convince them to take on the psychological, technical and financial problems.

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