

Choosing Soil-Cultivation and Sowing Machines for Growing of Winter Oilseed Rape

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INTRODUCTION

The rising price of crude oil and petrol products and the increase in demand for these products leads to a search for alternative energy sources. Oil-yielding agricultural crops are one of the most suitable raw materials for the production of biodiesel which is regarded as a possible solution to the problem at this stage of the development of industry. Two oil-yielding crops are common in Bulgaria – sunflower and oilseed rape. Rape has better characteristic features for the production of biodiesel. It is not surprising that the area of the fields that are dedicated to winter oilseed rape is continuously growing. The technologies and the fleet of soil-cultivation and sowing machines used for oilseed rape are quite different from those used for sunflower. This is the reason why it is necessary to carry out an analysis so that the most suitable set of machines and operations are chosen to achieve optimal yields from winter oilseed rape.

The aim of this paper is to examine the existing agricultural machines worldwide and taking into consideration some technological requirements and the specific soil and climate conditions in Bulgaria to suggest the most suitable soil-cultivation and sowing machines that are in accordance with the technical and technological requirements for growing rape.

THESIS

The main prerequisite for achieving good yields from oilseed rape crops is the timely and well performed cultivation of the soil. Cultivation of soil in oilseed rape production is sometimes carried out under severe conditions. Usually the operations start in the middle of August when the soil is extremely dry. This peculiarity, together with the need to achieve a garden-like condition of the soil, predetermines the use of various one-operation or combined soil-cultivating machines.

As regards the preceding crop, cereals such as wheat and oats turn out to be the most suitable. Depending on the time of their harvesting and the moisture content in the soil various operations that involve soil cultivation can be performed [2].

A common version of tillage is connected to destroying stubble with low moisture content. Under these conditions the soil is not very susceptible to mechanical tillage and most operations are energy consuming and the final result is comparatively bad. In such cases it is not possible to use the conventional stubble cultivators for joint cultivation with loosening working tools. Moreover, it is not advisable to use such cultivators for direct tillage of stubble in rapeseed growing. Machines of this type do not have the technical and technological potential to make the soil with a garden-like texture. To achieve the required result combined soil-cultivation machines equipped with several rows of disc sections and one or two rows of cage rollers should be used. When working on dry hard soils the disc operating tools loosen the soil in a better way while the rest of the operating tools only break the soil and form big lumps. On the other hand, disc operating tools cannot be used on their own because they leave clods with a comparatively big size. Therefore in tillage as a preparation for seeding of oilseed rape it is necessary to break these clods. This can be achieved using cage, pipe or rod rollers (Fig.1).

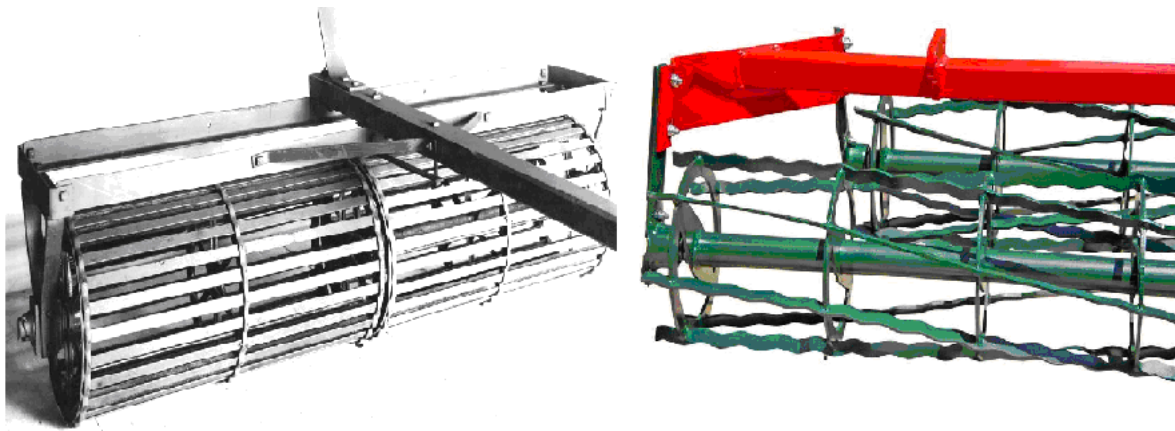


Fig.1 Cage and rod rollers

In addition, instead of these types of rollers, toothed roller crushers in a welded construction can be used (Fig. 2). It is recommended for the disc tools of these machines to be designed with a smaller diameter of 330 – 350 mm so that smaller clods are formed. Toothed roller crushers additionally scarify and loosen the soil and at the same time they ensure an even seeding at a smaller depth and reduce the evaporation of the moisture from the soil.



Fig.2 A disc cultivator with a toothed roller

With comparatively early preceding crops it is possible to plough-in the stubble using ploughs specially designed for this purpose equipped with clod-breakers or toothed seed harrows (Figures 3 and 4).

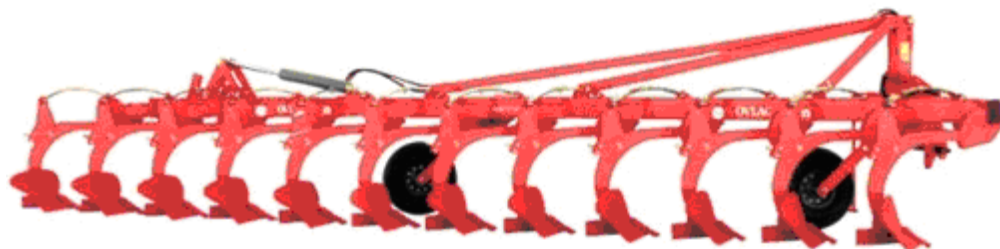


Fig.3 A plough used for ploughing-in of stubble.



Fig.4 A plough equipped with a clod-breaker

Using this type of ploughs ensures the destruction of weeds and the storing and preserving of moisture in the soil. It serves as a good preparation for the next operations of tillage and the final result is a texture of the soil that is very close to the garden state. After the ploughing-in, machines with disc operating tools as well as combined machines for soil cultivation with cutting and scarifying tools can be used. They can be combined with roller crushers again. If it is possible, combined machines should be used. A possible version of tillage is to apply an active harrow with a vertical pivot and a roller crusher mounted on it after the ploughing-in (Fig. 5). Thus it is possible to achieve a garden-like texture of the soil with one drive only. This technology is the most energy consuming but it ensures the optimal quality.



Fig.5 An active harrow with a vertical pivot

After the ploughing-in has been completed the cultivation of the soil can be continued with a combined machine which consists of spring-tined scarifying tools placed in several

rows and followed by rollers. Using such a machine leads to a greater productivity of the aggregate and reduces the losses in soil moisture. It also helps farmers achieve a better density of the soil that guarantees an even depth of sowing of the rape seeds. A possible disadvantage is the lower quality of the tillage in drier soils. In normal conditions when the moisture in the soil is enough, these aggregates are as efficient as the active cultivating cutters with a vertical pivot.

In the past years the sowing of winter oilseed rape was carried out with mechanical seeders with a jet seeding tool designed primarily for cereal crops. Using such seeders would be a sort of compromise. The results are not satisfactory as a rule due to several reasons. Firstly, the achieved depth of sowing is uneven and secondly, it is not possible to maintain a low amount of seeds per hectare i.e. a low seed rate. In the new models of seeding machines this problem is solved by combining the jet seeding implement with a pin seeding implement in a common body. Thus by transferring the motion between the two implements sowing of both cereals and oilseed rape (which has very small seeds) can be achieved. It is recommended for the furrow forming operating tools to be of the anchor type forming obtuse angles so that the moisture of the soil is not taken out and the capillary phenomena are activated [1]. This enables the fast initial germination and the further simultaneous sprouting. Since anchor furrow forming tools with an obtuse angle are not particularly suitable for cereal crops, most machines are equipped with disc furrow forming tools. To sow oilseed rape at a smaller depth (of about 2cm) the disc furrow forming tools are connected to the rear wheels via a solid connection thus allowing the rear wheels to play the role of rollers as well (Fig. 6).



Fig.6 Connecting the furrow forming tools to the rear wheels

In seeding machines with a great working width maintaining a low seed rate necessary for the sowing of winter oilseed rape can be achieved by using a central mechanical sowing apparatus combined with a pneumatic transportation of the seeds to the furrow forming tools.

Taking into consideration the advances in technology in the last few years combined machines for soil cultivation and sowing are becoming more and more widely used. They are suitable for oilseed production as well. The use such machines reduces the number of passages on the field and decreases the time for sowing as well as the packing and hardening of the soil. The most common combination of a soil-cultivating and a seeding machine comprises several rows (2-3) of disc working tools, a board that flattens the surface and breaks the clods additionally and furrow forming organs which can be of the disc or anchor type and wheels that press the soil. This is the underlying principle of operation in the machines of companies such as: Vaderstad, Amazone, Kverneland, etc. which are used in Bulgaria quite successfully.

Conclusion

The analysis that has been carried out shows that as regards the machines used in the production of winter oilseed rape, the following conclusions can be drawn: There is no universal combination of agricultural machines for oilseed rape growing. Each case is unique and every time the soil and climate conditions should be taken into consideration when making a decision about the optimal set of machines.

- It is recommended to use combined machines for soil cultivation and sowing because this leads to a greater efficiency, to a reduction in the packing and hardening of the soil and to decreasing the time needed to perform the sowing itself. If the rest of the conditions are the same, these machines ensure better results.
- Depending on the area of the fields that have to be cultivated for the production of oilseed rape, two types of agricultural machines can be used – ones that have active and ones that have passive soil cultivation organs. Active organs are suitable for smaller areas because of their lower productivity and greater energy consumption. On larger areas, aggregates with passive organs with a bigger working width should be used.

References

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