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Trends in tillage

Fig. 1: In the VariTansanit, the control of the hydraulic upper link puts additional weight on the rear axle.

Below, important trends in tillage are presented which are going to be reflected by the implement- and machinery programme shown at the Agritechnica 2005. This preview only provides pre-information and cannot replace a trade fair visit. Completeness is not aimed for.

Demands on tillage with regard to the choice of implements and the conditions of use are growing steadily. In areas susceptible to erosion, for example, a certain degree of soil coverage is required depending on the location. In addition, a large part of the straw must be incorporated evenly in order to rot quickly and to reduce the disease potential for the successive crop. Often, the necessary incorporation of straw (= „dilution effect“) requires greater loosening depth than actually necessary due to the kind of soil and vehicle use. Generally, crop-rotation-specific loosening is most profitable.

Stubble cultivation from superficial to deep

A lot of development work has been invested into the work quality of combine choppers. Nevertheless, too many buyers still rely on the factory configuration when purchasing a new machine without checking current lateral straw distribution even though it decisively influences the quality of straw incorporation. With the aid of a wide-meshed garden rake, lateral distribution can be checked in an elegant and time-saving manner. Straw is swathed such that it covers two to three working widths. The swath volume then indicates the evenness of lateral distribution. For improvement, the inlet openings and the opening angles of the baffle plate must be adjusted.

What counts for the first stubble cultivation pass is superficial working, good reconsolidation, large area capacity, and low fuel consumption. Under these aspects, short-disc harrows, which have been available for several years, are setting the trend. Smooth or serrated discs suspended on two beams, which feature different diameters and in some cases an angular position, are offered by almost all manufacturers. A very compact design allows 6 m wide mounted implements to be realized which are highly manoeuvrable and provide purchasing cost advantages. However, their disadvantage is that they put heavier loads on the headland. Implements which have larger working widths are semi-mounted with the packer roller serving as a chassis on the road. Some short-disc harrows are designed such that they can also be used as a trailed secondary soil tillage implement in a versatile manner and thus allow costs to be reduced.

A special implement for superficial cultivation requires a special implement for deep stubble cultivation. For this purpose, the consistent use of a 4-beam cultivator with simple, short-mounted solutions for the coverer and the packer roller is recommended. A tine distance of 20 to 23 cm and 10 cm wide shares are used for working depths of up to 15 cm or 5 cm wide shares for even deeper cultivation. The basic principle is: „cultivation depth = tine distance“. Since the lateral loosening conditions are characterized by better aggregation in heavy loam soils, tine distance may be up to 1.5 times larger than working depth, and the share can rather be smaller than in sandy soils.

The second cultivation pass not only incorporates straw, but is also often considered basic tillage in conservation tillage. In order to allow crumbly soil to dry by the time of cultivation, a large pipe cage roller is often sufficient as an end roller, whose only task is crumbling and depth guidance, whereas the packer roller in the cultivation combination reconsolidates the soil. In order to keep the expenses for double mechanization within tolerable limits, a wide short-disc harrow should be used cooperatively.

In addition, combined implements are offered for individual farm mechanization. These are often 3-beam cultivators as mounted implements, which are equipped with discs as a levelling unit and a heavy packer roller for reconsolidation. The comb tines installed between the tool units only make an insignificant contribution to better lateral straw distribution. Tine distance is 25 to 30 cm and requires wider shares, such as 15 cm wide duck foot- or stubble shares, for initial cultivation. These shares cut off large furrow slices. Straw incorporation, however, is often insufficient because the furrow slice does not rise and fall onto the straw from above like in the spiral- or double-heart share.

Especially 2-beam wing-share cultivators no longer meet the increased demands of stubble- and basic tillage as part of conservation tillage and should be replaced by better cultivators when new implements are purchased.

The universal use of a cultivator, i.e. from superficial to deep stubble cultivation and for plough replacement, requires different shares with a quick-change system and two exchangeable packer rollers. Whether this

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still means cost savings in comparison with cooperatively used special implements must be considered in the individual case. In order to solve this goal conflict between superficial cultivation at a large working width and deep cultivation at a narrow working width, hydraulically folding mounted or semi-mounted cultivators are available which can be folded out for superficial cultivation and folded in for deep cultivation. This enables tractor use to be optimized.

On large farms, cultivator-disc-harrow combinations having large working widths are still predominant as universal implements, whose tine fields can be hydraulically adjusted during the ride in some cases and which are suitable for GPS. Semi-mounted cultivators for superficial and medium-deep cultivation are meanwhile also offered for working widths of 10 to 12 m.

Basic tillage - what to do with the straw?

Inverting tillage with a plough
Under moist conditions, the plough keeps its importance because highly ploughed, crumbly soil is still suitable for cultivation under these conditions. The plough is also the most important tillage implement in organic farming because it takes over the task of mechanical weed control.

The tyre inflation pressure of the plough tractor should be approximately 1 bar in particular in order to prevent plough pan formation. When large quantities of harvest residues, such as grain maize, must be removed in one work step, the plough is used with extended frame dimensions. Only in the first year after replanting, however, do ploughed-under residues provide reduced infection potential for plant diseases. The height and the angle of manure attachments can now be adjusted quickly with the aid of socket pins.

In order to solve the tractive force problem of semi-mounted ploughs, weight is transferred from the support wheel to the tractor by means of constant upper link pressure. Approximately 1 t in 4-furrow ploughs and 2 to 3 t in wider ploughs rest on the support wheel. Accordingly, the support wheels must be largely dimensioned in order not to exceed tyre inflation pressures of 1.5 bar. While 8- to 10-furrow ploughs are exclusively used „on-land“, there is little demand for this technique in small ploughs.

For „superficial ploughing“, four manufacturers meanwhile also offer technical solutions in the form of fully reversible or pivoted till ploughs. Inverting tillage, which is required under some cultivation contracts, is combined with large area capacity and lower fuel consumption. Functional reliability depends on even straw incorporation down to a depth of 15 cm and requires well-pouring soils. These ploughs are an interesting additional implement for machinery rings and contractors.

Conservation tillage
Special loosening implements for conservation tillage, such as the para-plough, the para-cultivator, or the deep loosener have lost in importance. The ability of implements to loosen the soil below the tractor wheel pan is only requied in isolated cases. High costs and a soil structure susceptible to compaction after deep loosening (if the soil is not stabilized biologically by means of intermediate crops) speak against the use of these implements as a routine measure. If topsoil-deep loosening is necessary after the field has been driven over, 3- to 4-beam cultivators with narrow chisel shares or cultivator combinations with special loosening tools are used. This often means basic and secondary tillage in one work step. Working depth is relative to straw incorporation and not the necessity to loosen the soil.

Secondary tillage remains coupled with drilling

Both short-disc harrows and cultivator combinations offer the possibility of combination with an available drill. This combination is predominantly used for intermediate crop cultivation for green manuring or on set-aside areas. Seedbed combinations used alone or in combination with drills are mainly employed after ploughing in regions where precipitation is below 500 mm.

On medium to heavy soils and for conservation tillage, PTO-driven cultivation combinations are predominant. The rotary harrow tines should interlock because this combines better straw incorporation with an improved ability to draw into the soil. Tine speed is generally changed by altering the rotational speed of the tractor PTO. If this is not sufficient, a transmission is necessary because changing the gear wheels is too time-consuming. All manufacturers meanwhile offer packer rollers according to the principle of „specific heterogeneity“. The soil is reconsolidated only in the seed furrow area in order to provide even coulter depth guidance and to improve capillary water flow. The space between the furrows remains loose and coarse-crumbled for good infiltration.

One reason for the rare application of mulch drilling on these soils is that no PTO-driven drill combinations are used on sandy soils, which are easy to cultivate. Since the cultivation of sugar beet and potatoes may result in significant soil erosion, mulch-seed-capable cultivation combinations should be introduced there for reasons of soil protection.

Conclusion

The necessity to save expenses and the demand for the consideration of soil protection are going to support the development of conservation tillage. In combination with greater variation in crop rotation, the problems of this cultivation system will be solved. All in all, lateral straw distribution by the combine must be improved further, and attention must focus on the use and the work quality of implements for stubble- and ground-soil cultivation.

The quantity of straw, the time of the harvest, and the condition of the soil when it is driven over decide how much loosening is necessary during tillage. Reduced, crop-rotation-specific loosening selectively eliminates topsoil compaction, maintains the carrying capacity of the soil, and is most profitable.

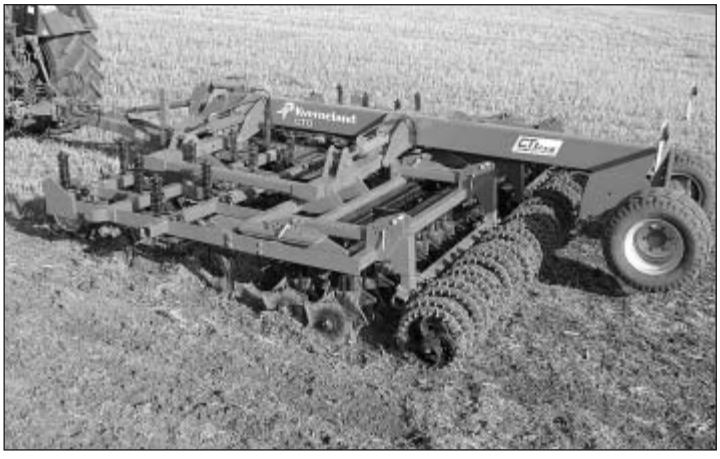

Fig. 2: Depending on the cultivator shares chosen, the CTO from Kverneland is reportedly suitable for soil cultivation from 5 to 25 cm. Two rows of rotor stars serve to crumble and reconsolidate the soil.