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Trends in plant protection technology

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

In 2004, plant protection implement sales in Germany amounted to approximately € 50 million. As compared to the previous year, it increased by about 20%. Thus, plant protection implements account for 1% of the production volume of the agricultural machinery industry in Germany (€ 45.3 billion). Sales of plant protection products in Germany reach an extimated € 1,100 million. Since these sales figures are often attributed to the innovativeness and great capacities of the companies which achieve this result, the plant protection implement industry, which has always reacted to more and more sophisticated plant protection products by developing new implement-technological solutions, will continue to occupy a leading market position.

Mounted implements

Mounted implements account for 36% of the companies' product range. They reach working widths of up to 28 m and a container size of up to 1,800 l. The tractors commonly used for this purpose often need additional front ballasting in order to conform with the road traffic regulations if the container is full. The containers feature a compact design and are equipped with cleaning equipment, clear water containers, and detergent dispensers (optional) so that implement cleaning on the field is possible without any problems. The implement valves can be operated and monitored from the cab. For this purpose, simple mechanical as well as electrical/electronic operating systems are available. More and more often, the operating elements for filling, cleaning, and emptying are concentrated in one place on the implement. This facilitates implement operation and helps to avoid operating errors. The booms are preferably folded as a package (horizontal or vertical) because lateral folding may lead to problems with the cab in some cases. Implements having a working width in excess of 13 m must be equipped with a swinging system which keeps the booms in a stable position even if the ground in the tramlines is very uneven.

Trailed implements

In the statistics of the Federal Biological Research Centre, trailed implements occupy second place (40%). The manufacturers offer implements having a working width of up to 45 m and a container volume of up to 7,000 litres. The valves/devices required for filling, cleaning, and emptying are preferably concentrated on the left side of the implement in a so-called operating centre and marked well. The operating elements relevant for the spraying process as well as the measuring- and monitoring instruments must be easy to reach and clearly legible from the driver's seat. Therefore, a remote-controllable valve is considered minimum equipment. The valve generally features a dissolved design (control valve near the pump, switching of boom sections at the boom). This has a positive effect on the technical residual quantity, pressure drop, and the quality of lateral distribution. Nozzles are generally switched in fixed boom sections. Pneumatic switching provides greater variability and even the possibility of switching individual nozzles. If the spray pipe is designed as a ring pipe, the full concentration of the plant protection product and the set spraying pressure are available immediately at all nozzles when spraying starts at the beginning of the field. The circulation system also proves advantageous for implement cleaning. For this purpose, the manufacturers use different technical solutions, for which larger technical residual quantities may be available. Today, trailed implements are generally equipped with control systems which provide a constant sprayer output. The precision and control dynamics of these control systems enable fluctuations in spaying speed and nozzle switching to be compensated for. Multiple nozzle bodies are helpful because they allow nozzles to be switched without greater time requirements. Some manufacturers offer electro-hydraulically switchable multiple nozzle holders which also enable several nozzles to be operated simultaneously in one position. The operating elements, the display, the monitor, and the multi-functional lever are designed very differently so that the user can choose what suits him best from a wide range of products. In the case of electronic system failure, emergency operation should be possible in any case so that the treatment underway can be completed. In trailed implements, boom widths continue to increase significantly. In this kind of implement, hydraulic folding is standard. Studies on dynamic distribution quality have shown that booms keep a stable, still position under practical conditions of use and provide very uniform spray coating. Due to their stable ride behaviour, trailed implements are clearly superior to mounted ones. For the outer cleaning of the implements, steel pipes with special nozzles are meanwhile available which can be supplied with fresh water either by the implement pump or a separate high-pressure pump. More and more mounted implements allow for high travel speeds. The manufacturers offer implements designed for up to 50 km/h and equipped with sprung axles. Double-pivot steering or an articulated drawbar enable directionally stable trailing to be realized.

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Keywords

Trends of development, plant protection technology, sprayers and atomizers

Fig. 1: Efficiency through size ñ the Dammann-trac DT 2600 H 3A with a container volume of 10,000 litres

Self-propelled implements

Meanwhile, self-propelled implements account for 11% of the manufacturers' product range. These implements can be optimally adapted to the conditions of use and feature versatile technical equipment. Capacity (with regard to tank size, working width, travel speed) and operating comfort (comfort cab, computer-aided monitoring and control of virtually all functions) fulfill the greatest demands. The largest possible area capacity, easy oeration, good manoeuvrability, and the most even possible weight distribution over the wheels, which allows for precise application as well as good ride- and operating comfort even under difficult terrain- and soil conditions, are particularly interesting for contractors and large farms.

The purchasing price of these self-propelled implements is twice as high as the price of comparable trailed implements. However, progressing structural change in agriculture, more cooperative machinery use, and the narrow time schedule for plant protection measures are promoting the trend towards these large implements. The manufacturers are meeting the demands of this development towards large, efficient self-propelled machines by offering chassis which have up to three axles and are designed for a travel speed of 50 km/h. These machines now feature tank sizes of up to 10,000 litres and working widths of up to 45 m.

Nozzle technology

The nozzles are a very important part of a plant protection implement because they are one of the factors which decide whether a plant protection product can develop its full potential or whether crops are harmed or even neighbouring crops and non-target areas (stretches of surface water, biotopes) are damaged. In recent years, nozzle development has been directed towards coarse atomization with a small/minimum percentage of fine droplets. Numerous effectiveness tests have shown that the injector nozzles which are currently available on the market generally cause no or (at most in a few special cases) slight restrictions of effectiveness. Injector nozzles are characterized by extraordinarily high drift stability, which may result in a drift reduction of up to 90% depending on nozzle size and -type.

Today, drift reduction is of particular relevance for practical plant protection because the minimum distance from stretches of surface water and fringe structures which is required for plant protection products does not have to be observed when drift-reducing plant protection implements are used. Additional air assistance also allows drift to be reduced, though only in taller crops. For band spraying, a drift reduction of more than 90% has been proven.

Filling and cleaning of plant protection implements

The experiences of the past years have shown that increased plant protection implement concentrations in stretches of surface water can be explained in particular as a result of locally limited inputs, which must be attributed to improper filling and cleaning of plant protection implements and plant protection product containers on the farm. Large refilling containers, which are meanwhile offered by several companies for all important products, are an efficient measure which allows these problems to be solved. This becomes possible because the precise quantity of plant protection products needed can be taken from these refilling containers through a closed tapping system without the user getting into contact with the concentrated product or the soil getting spattered with it. In addition, it is unnecessary to rinse the large container on the farm when it is empty because the companies have obliged themselves to take the large refilling containers back unrinsed. So far, mainly large farms buy their plant protection products in large refilling containers and have equipped their plant protection implements with appropriate tapping systems.

Computer-based control

Today, large, efficient plant protection implements are generally equipped with computer-based application rate control. The current trend is favouring ISO-BUS-capable electronic equipment. In recent years, the manufacturers have integrated more electronic systems into their products in order to improve the functionality, the productivity, and the comfort of their machines. This often also includes a GPS (global positioning system), which allows the position of the implement to be determined precisely by means of satellite navigation. The ISO-BUS enables the mounted/trailed implement to be operated and controlled from the terminal in the tractor cab.

Currently, data exchange between the tractor terminal and the farm computer is being realized on the basis of this standard. This allows work on the field to be planned on the farm computer, e.g. on which field or at which customer's which products at which dose rate are intended to be applied with which machine and which driver. These tasks are transferred to the mobile system in a standardized XML format via a USB stick. On the mobile system, the orders are carried out, the work is recorded, and the results are stored and re-transferred to the farm computer for evaluation.

Non-chemical methods of plant protection

In organic farming and paved urban areas, mechanical (hoes, brushes....) and thermal techniques (scorching, infrared technology) are applied. Hot foam application, which is particularly suitable for weed control in the municipal area, must be mentioned as a true innovation among thermal techniques.

Electron dressing is an alternative to chemical dressing. In this method, the biocidal effect of low-energetic electrons is used to control seed-borne microbial pathogens.

In stored product protection, inert gases (nitrogen and carbon dioxide) are increasingly being used instead of methyl bromide (which was taken from the market towards the end of 2004 because of its ozone-destroying effect in the stratosphere).