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Vegetable planters

In recent years there have been some important developments in the vegetable planter sector such as fully automatic planters.
Additionally, there have been many smaller improvements in conventional planters which have helped improve plant quality and increase work efficiency.

Nowadays, vegetable farms use two different seedling systems for planting: pressed soil pots from 3 to 6 cm used mainly for lettuce types and small rootball seedlings which have been brought-on in plastic trays, a system suitable for all cabbage types, celery, leeks, medicinal and herb plants with tray sizes of 144 to 600 cells used.

Smaller vegetable farms with a wide variety of crops require a universally applicable machine capable of planting both types. This is possible with conventional nocken roller, ring roller, disc furrow, planting wheel, snap-grip and clamp belt implements such as those from Accord, Super Prefer and Heyne which have already been on the market for some time and will not be gone into here.

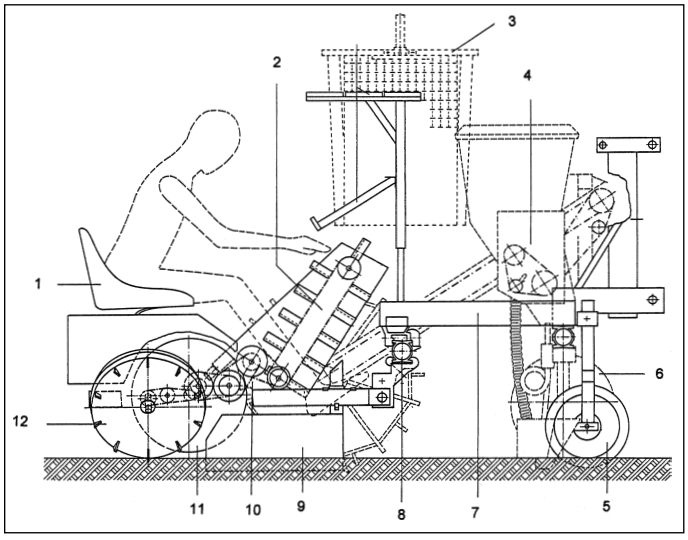

Fig. 1:Planting machine requirements based on a clamp disc machine with chain and cup magazine: 1.ergonomically-designed work position, 2. cup and chain as magazine, 3. storage platform, 4. additional equipment for placed fertilising, 5. steplessly-adjustable front runner wheel, 6. pressure roller for reconsolidation, 7. double frames, 8. plant aggregate extra, 9. plant coulter, 10. synchronised spur gear and chain drive, 11. clamp discs, 12. pressure wheels.

On larger vegetable farms, the trend is for special implements for handling either pressed soil pots or small rootball seedlings. The implements are fixed at the required row centres (around 50 cm for cabbage or 25 cm for lettuces).

Recognised as important requirements for planters are:
- good and healthy young plants
- good soil preparation to plant depth, fine crumbing for small rootball seedlings
- good plant quality with satisfactory plant performance

For this, the requirements for the planter *(fig. 1)* are:
- consistent positioning at predetermined distances and depth, vertical positioning of plant in the soil
- good consolidation of soil-ball to establish ground connection and rapid establishment (ballasted pressure roller)
- high plant performance
- transport of enough plants to keep reloading downtime as low as possible (trays for small rootball seedlings must be vertically placed!)
- non-tiring operating position, e.g., with comfortable seating
- good work quality, even where ground conditions are not perfect

Additionally, there must be the possibility of planting longer (higher) plants. In many cases the material cannot be directly planted on delivery because of weather conditions and grows further. Even then, the planting technology must be able to function perfectly.

Further, it is important that the plants are firmly established at the right depth so that the weeding implements can loosen weeds without damaging the crop plants. A good depth also means the plants are less susceptible to damage when the wind moves the plastic mulch.

Named in the following list are modern planter types such as cup and belt implements whereby the makers named are used only as an example of the different systems.

Cup planters

Cup planters enable storing of a reservoir of

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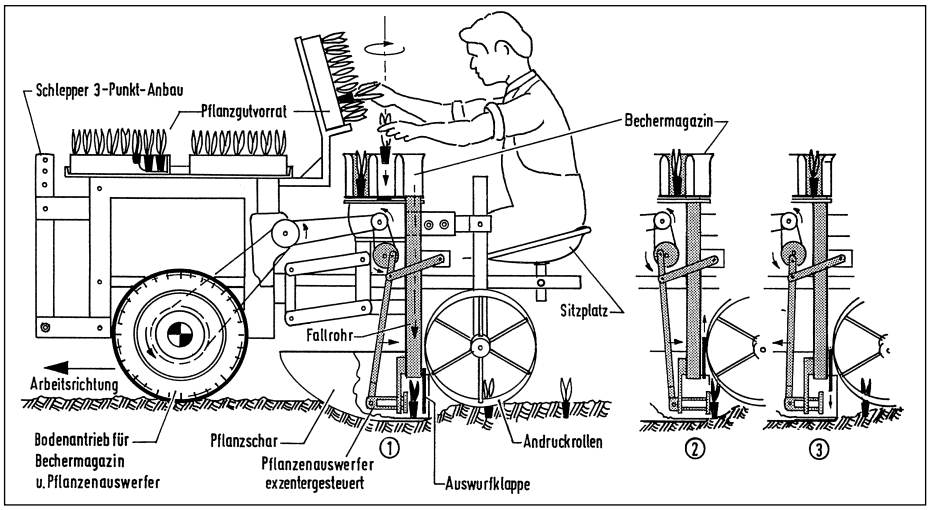

Fig. 2: Planter with revolver-head magazine (plant conveyance in closed coulter)

plants in horizontal or vertical cups and thus achieve a higher planting performance than the conventional clamp disc type. Some makes include cup fitments for different types and sizes of plants.

The plants are very precisely set into the furrow by vertically revolving cups. With the horizontal cup system the plants fall either freely directly into the furrow or via a share or coulter closed underneath *(fig. 2)*. Here they can be slowed by spokes as well as conveyed within fixed or movable pipes *(fig. 3)*. The plants are pressed into the furrows out of the enclosed coulters by synchronised ejectors.

Along with the possibility of back-up storage with the cup implements, advantages include the positioning of the cup magazine at knee height which allows an ergonomically suitable operator positioning and thus less tiring action.

The Finnish Lännen RT2 implement has horizontal cups for planting of small rootball seedlings and small pressed soil pots. Individual attachment and conveying of aggregate on an implement rail allows achievement of a good and consistent planting depth. A spoke wheel slows the plants and sets them vertically into the furrow.

The „Tex“ planter from Checchi & Magli in Italy also has horizontal cups. The plants fall out of the magazine without being retarded into the coulter and from there are ejected with precision and consistent spacings into the furrow. However only small rootball seedlings can be set because coulter and ejector are shaped for this.

The „Rotoplanter“ from the Belgian firm Lauwers, again with a horizontal cup system, handles both plant types and the planting elements are individually attached giving a good, consistent depth of planting. The plants fall from the magazine through a drop-pipe which makes a circular motion with the flap at the bottom of the pipe only opening when the pipe is vertically positioned. This evens-out the travelling speed and enables exact placing of the plant.

The Italian-made Ferrari planter also uses a horizontal cup magazine. The plants fall into an enclosed coulter from where they are ejected precisely into the furrow.

Several implements feature vertically running cup wheels with which, as mentioned, the plants are directly set into the furrow or seedbed without any fall.
The Belgian „Standard“ planter from Perdu is suitable for planting both types.

Four cups are attached to the vertically revolving disc. The plants are directly and very precisely set into the furrow. Through limited storage possibility the planting performance is not very high, planting quality is, however, very good.

A further development is represented with the „Perdu 4000“ planter which is also suitable for the pressed soil pot up to 6 cm and small rootball plants. The plants are placed into many cups on a circulating chain giving a relatively large reserve and thus enabling a relatively high planting performance. Good experience has been recorded with this implement especially with cabbages.

Whilst the above mentioned implements set plants in the furrow, the „Wolf“ planter from Checchi & Magli sets plants directly into the ground without a furrow out of four cups on vertically revolving discs. Planting into plastic mulch is possible with this system.

One worker per plant row is generally required for the latter implement. Performance lies between 3000 and 4000 plants/man hour. Plant spacing is adjustable from 10 cm. Row spacings are usually 50 cm with staggered delivery of plant aggregate required. Purchase price is from 3000 to 4000 DM/plant row.

The „Due“ implement from Italian firm Hortus features an interesting development with a vertically revolving cup system loaded with plants via a conveyor belt. Here, even tangled, inter-rooted, rootballs can be used because they are automatically separated. The implement is suitable for 4 cm pressed soil pots. The plants are conveyed below and placed into the furrow without a drop. One worker looks after two rows with a possible performance of over 4000 plants/man hour. Larger plants can also be set with this implement.

Belt planters

Belt planters are special machines for pressed soil pots of 4 to 5 cm. The plants are stored on a belt, conveyed downwards and set automatically into the furrow.

One worker can handle several belt rows and enabling planting performance of up to 6000 plants/man hour. The planting quality with regard to spacing, depth and individual setting is however not always satisfactory. Implements with forced separation work more precisely.

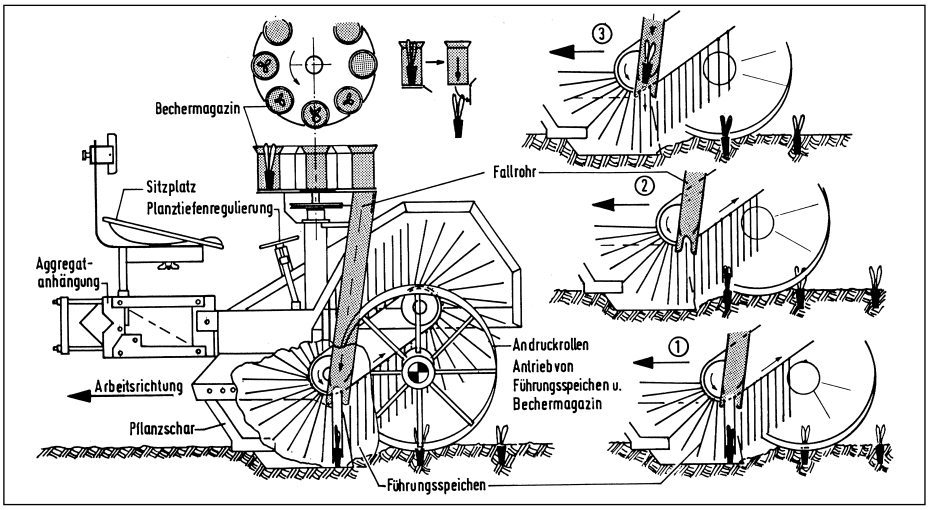

Fig. 3: Planter with revolver-head magazine (plant conveyance directly into the furrow).

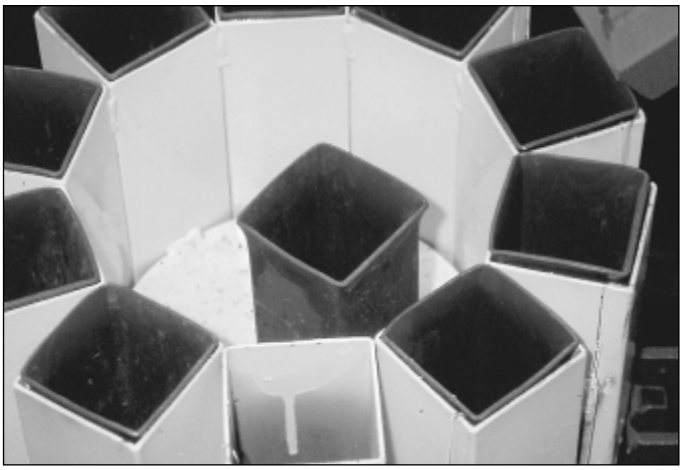

Fig. 4:Planter with horizontal cups

The Marschall company's machine from Munich presents a development which can separate even strongly inter-rooted and overgrown plants via a system of v-belts running at different speeds. The separation equipment can be retrofitted to other makes.

The Postertz planter from Germany uses single cups which can insert small plants very precisely Sometimes two plants land in the furrow together, also in-row spacing is not very consistent However, anyone accepting these disadvantages is served well by a machine which is very cost-effective. Plant spacings in-row can start at 7 cm so that valarienella salad can be planted.

The „Delta" machine from the company Dürselen functions according to the same principle and can be set with seven rows for valarienella.

Further belt planters are also offered as self-propelled machines by the Dutch firm Basrijs, by Ferrari and the Swiss Meder company as well as the German Schneider firm (self-propelled).

In each case planting can cover up to seven rows with in-row spacing adjustable from 5 to 70 cm and row centres beginning at 23 cm. Price range is from 6500 to 28000 DM.

Seen in general there is a large choice of planters for all growing systems and also for all types of vegetable production enterprises. Field testing of any planter is an absolute necessity before purchase.

Fully automatic planters

Fully automatic planters have been working in Belgium, France, the Netherlands and England since the 1998 season on over 200 ha. Thus, practical experience exists which allows valuable information and decision aids for this technology. The breakthrough for a fully automatic planting of vegetables appears to be now underway with application of further such machines being planned.

The use of small rootball plants is a requirement for the fully automatic systems. These lie individually in trays from which they are automatically ejected and then planted by the machine according to field position control.

With most of the planters only certain tray measurements and types – thus special makes of tray – can be used. Some machines plant only pressed small rootball plants (super seedlings), others can also handle loose small rootball plants (speedies).

As a rule the two to four row machines are manned by a maximum of two operators plus the tractor driver. Planting performance runs at two plants per worker, row and second, thus in practical terms between 5000 and 7500 plants per aggregate and hour.

Most makes have optical sensors which monitor, and make up for, plant misses.

The relatively high purchase price of up to 50000 DM per planting aggregate certainly justifies only multi-farm operation through, e.g., a contractor on contract to a young plant enterprise. In this way, the vegetable farmer can buy his young plants „already planted".

Five makes so far working in Europe.

In the Netherlands there is experience with the Italian model „Ferrari Futura". It can plant loose and pressed small rootball plants from all types and sizes of trays. In other words this is a very universal machine. The plants are pressed out of the trays by compressed air powered fingers. A whole row of plants is pressed out at one time – up to 10 plants. Where trays have 21 plants, seven plants at a time are pressed out. One gripper takes the plants into a cup for selection. All ten cups are monitored via electronic „eye". If a cup is left empty the chain automatically speeds up and receives an extra plant.

The floor of the selection cup subsequently opens and gives the plant further to the cup carousel on a revolving chain similar to the semi-automatic Ferrari machine. The plants are then automatically transferred from there via drop-pipe into a coulter and from there set into the soil by an ejector system.

The speed of the ejector is synchronised with the revolving speed of the cup chain and gives the plant spacings in the row. The plant is then firmed with two pressure rollers. The empty tray is automatically set aside and stacked.

Basis of the „Agriplanter" machine from Belgium which was first demonstrated in Germany in 1998 is a Japanese fully automatic planter for sugar beet seedlings in paper pots. In Japan around 7000 of the machines are working with around 60000 ha planted annually.

Through the initiative of the Belgian company Agriplant, Dadizele, important further developments on the current machine was carried out by the Japanese engineering firm Circle Tekko. Firstly a two-row planter (Agriplanter 2S) was developed. This was put to work in Belgium, France, the Netherlands and England.

Requirement is for a fully interruption-free application is the use of trays with cylindrical, lightly pressed little pots (super seedling). The less firm and consistent the pots are, the more imprecise the planting. Aim of this system is planting at 97% precision.

Six different trays can be used with the Agriplanter. The plants are pressed out in rows (around 15 plants) grabbed by needle grips and automatically deposited on a conveyor belt. An optical sensor monitors the rootballs on the conveyor belt. If a ball is missing the belt speeds-up and shoves the following plant forwards thus making-up possible misses. A knobbly clamp belt then takes over plant transport downwards and transfers the plants onto two vertical clamp discs for setting into the ground.

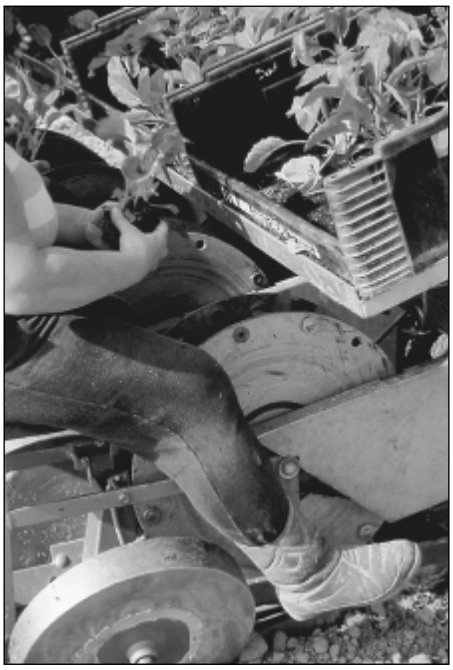

Fig. 5: Planter with vertical cups

There is now a four-row planter (Agriplanter 4S) where two plant streams are separated into four: two streams in each aggregate.

A further fully automatic planter from Japan is the „Minoru“, marketed by the Dutch firm Visser. Available is a one-axle planter with a two-row planter or a tractor mounted implement with up to eight rows.

However, special trays measuring 60 • 30 cm and holding 220/440 lightly pressed little pots are required. Of these, around 40 mill. units have been produced since 1980 in Japan for onion and rice seedlings. These are very light and flexible trays with a working life of around seven years.

The single-axle planter with the title OP290 is operated by a single worker. Possible in-row spacings are from 5.8 to 60 cm and row centres from 90/100 cm. At a working speed of 5 to 6 km/h 0.3 to 0.4 ha/day can be planted. Planting depth is from 1 to 4 cm. Plants from 8 to 20 cm in length can be set.

The mounted model VPT-8 is a development from the sugar beet, rice and onion production and functions on the same principle. It is suitable for celery, broccoli, cauliflower and other cabbage types. The plants should have a height of from 8 to 15 cm. Two rows per seedbed are planted with row centres of 30, 35 or 40 cm. In-row spacings are adjustable from 13 to 25 cm. The eight row machine plants two rows per seedbed over four seedbeds.

The trays flex as they are loaded vertically into the machine. The root balls are knocked out of the little pots from behind and laid out further below via a holding system onto a horizontal conveyor belt. At the end of the belt in each case one plant at a preselected distance is pushed downwards. The seedlings are then placed into the ground via a clamp band and two clamp discs. The planter is extremely compact and light.

The Australian firm „Williames“ produces growing-on systems for vegetable seedlings. The first positive experiences with the fully automatic planter come from cabbage production in England. Basic equipment features a four-row planter with row centres of 50, 60 and 75 cm possible.

The original tray measured 70 • 30 cm and loose substrate pots with cabbage, lettuce, celery and, in future, also leeks can be used. Presently in development for a Dutch seedling company is a tray measuring 40 • 40 cm with 224 and 256 pots.

Fig. 6: Fully automatic „Agriplanter“

Also being applied in England currently are the usual tray sizes 60 • 40 cm with 260 and 300 pots. The tray is fed into the machine (in the case of the 40 • 40 cm trays two can be loaded alongside one another). 32 plants are pressed out of the tray at one time and laid on a conveyor belt. At a bend the spacing between the plant holding devices is automatically increased. At that point there occurs an additional light pushing of the plants which then fall downwards into a coulter with a Teflon-surfaced groundplate. Subsequently the plants are precisely ejected from the coulter. Empty plant spacings on the moving conveyor belt are recognised by electronic selector and even-out through speeding-up of the belt.

Planting with eight rows is possible with the plant stream in the four drop-pipes split. The adjustment of row spacings is relatively simple. The working elements are pneumatically activated.

New on the market is a machine from the Finnish „Lännen“ company. This works according to the cup principle and applies a selector for evening-out empty spaces. From special 40 • 40 cm or 40 • 60 cm trays, two plants in each case are automatically pressed out per working beat, taken over by needle grabs and laid into plant cups. The machine should be suitable for all cabbage types, celery and chives. Up until now this has not been used in any scale. Planting performance is given at around 5000 plants per row and hour.

Literature

[1] Pflanzmaschinen und -geräte für Gemüse. Bauarten und Typentabellen. KTBL Arbeitsblatt 0647/1998 (Bestell-Nr. 26647)

[2] *Labowsky, H.-J.*: Pflanzmaschinen im Vergleich. Gemüse Spezial 1999, H. 1, S. 10-12

[3] *Labowsky, H.-J.*: Erfahrungen mit vollautomatischen Pflanzmaschinen. ZVG Gartenbaureport 25 (1999), Nr. 10, S. 18-20