

# **GRAND PRIX TECHAGRO 2018**

**Presentation of the exhibit of the company**



**P&L spol. s r.o. Biskupice, Czech Republic**

## **VARIOR 500**

**Cultivator for potato furrows with mineral  
liquid fertilizer application**

**Producer: P&L spol. s r.o. Biskupice,  
Czech Republic**

**The product competes in a special category  
Soil Water Retention Friendly**

**[www.pal.cz](http://www.pal.cz)**

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## Varior 500 Potato Cultivator

### 1. Machine characteristics

**Varior 500 Potato Cultivator** is technically and technologically designed for surface and subsurface cultivation of stalks and furrows to improve the retention capacity of the soil by higher water infiltration from rainfall or irrigation and to create appropriate conditions for efficient use of nutrients from applied fertilizers by plants (*Fig. 1*). The Cultivator disturbs crust the use of star-rollers on the surface of the pre-emergence period, creates or restores dents and dams in the non-runner furrow, cultivates the soil at the edges of the rail furrow after repeated crossings machines, and applies mineral fertilizers to the root zone of the plants. Using ultrasonic transducers that sense the position of the double row blades to the centerline, the hydraulic system of the machine receives instructions to move the sections to the extent that they usually copy the inaccurate connection of the two double-rows produced by the planting. The original design of the Varior 500 is copyrighted by 2 patent applications. The cultivator was developed and verified in cooperation with Crop Research Institute (CRI) Prague and Potato Research Institute (PRI) Havlíčkův Brod, s. r. o. with the support of projects of the Czech Ministry of Agriculture and TACR.



*Fig. 1: Varior 500 Potato Cultivator (autumn 2017).*

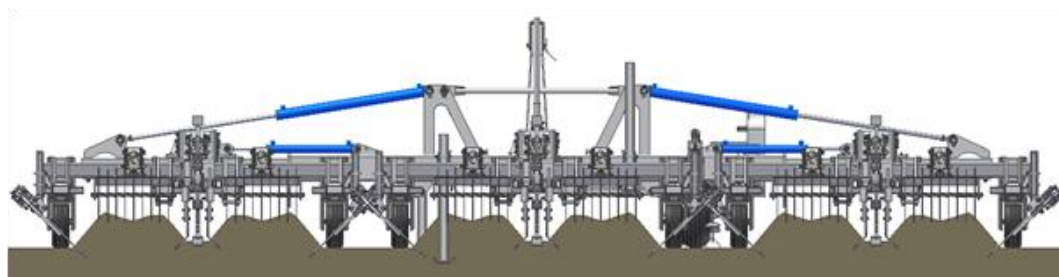
### 2. Technical and technological advantages of the machine

Varior 500 contains original, copyrighted working tools to increase the water retention of rainfall in stalks by loosening their hard crust by special star rollers and deep cultivation of the compacted soil layer on the sides of the rail furrow. These rollers form a preferential zone

near the plant roots for tapping water flowing from of the hips. It is also automatic to guide work sections for the side two rows using ultrasonic transmitters that give the impulse to the hydraulic system of the machine, which continuously guides the side section into a line of ranging 80 cm. The unique method is to apply liquid mineral fertilizers by chisels from the bottom of the non-tramline furrow to the root zone of the potatoes, followed by the formation of dents and dams in the wake from which the retained water from precipitation or irrigation is directed to the roots of plants with applied fertilizers. Potato cultivator Varior 500 is a completely new concept in potato growing technology, which is virtually unparalleled in the European market for similar products. This technology increases and stabilizes potato tuber yields (the greatest benefit in the dry year 2015), improves water retention and rainfall, and increases nutrient utilization from applied fertilizers while reducing the risk of water contamination.

### 3. Novelty and innovative product solutions

The Varior 500 have the original design solution has virtually no comparison on the market in EU. High work productivity ensures working time for three twin furrows with variable automatic guiding by ultra-ultrasonic transmitters (*Fig. 2, 3*). Two patents applied to the machine emphasize its technical maturity and novelty. The machine, using the original working tools, gently cultivate the surface of the potato scabs and disturbs the compacted layer of soil at the edges of the rail furrow, creating a preferential zone for infiltration of water flowing along the sides of the furrows. Said cultivation together with pitting and damaging the non-track line furrow creates suitable conditions for retaining water from precipitation and irrigation by spraying and limiting surface drainage. The retention of water in the non - tramline line worm with of stalks and furrows is directed to the root zone of the plants and to the places where the fertilizer has been applied, which, in comparison with other methods of application, increases the use of nutrients by plants, reduces their losses and the risk of water contamination.



*Note: Horizontal view of the profile shows the design of the machine in relation to three independent double twin furrows in the case where a double furrows potato planter was used.*

*Fig. 2: Machine work units VARIOR 500.*

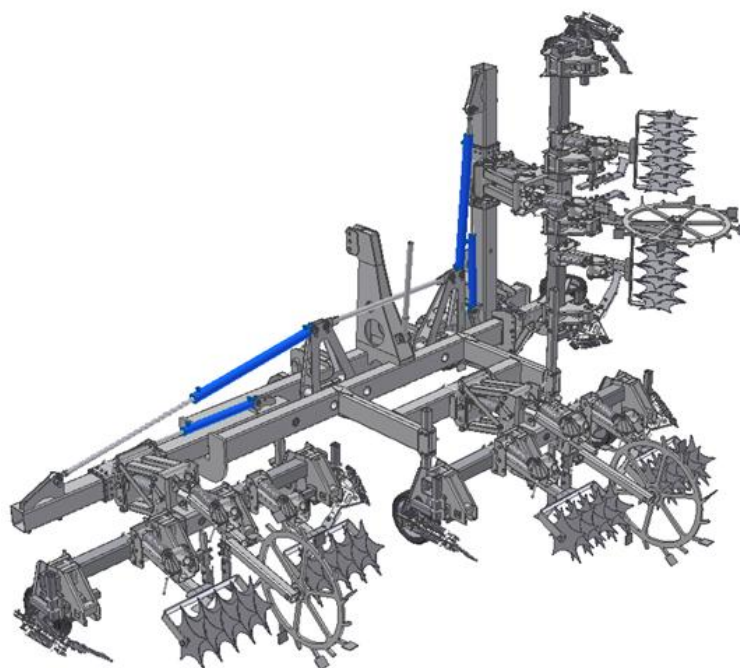


*Note: The picture shows the disruption of the soil on the surface of the furrows, the cultivation at the edges of the rail furrow and the renovation or the creation of dents and dams in the non-tramline furrow.*

*Fig. 3: Machine work units VARIOR 500 during cultivation.*

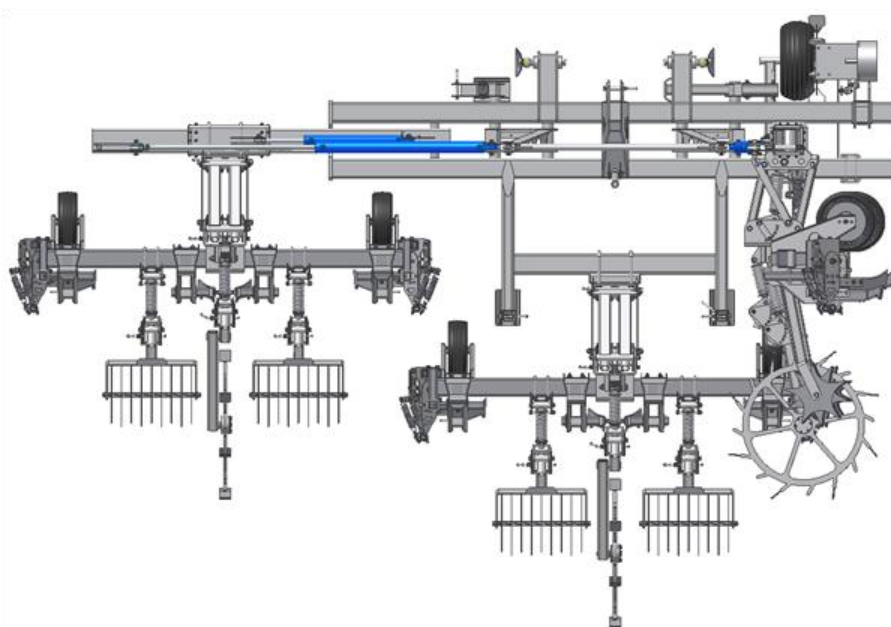
#### **4. Technical solution**

The machine is designed to be mounted in the three-point hitch of the tractor. The central part of the frame is made of a truss construction made of tube profiles and is sufficiently massive (Fig. 4, 5). On this part of the frame there is a liquid fertilizer tank with a capacity of up to 500 liters and a pump drive for application of fertilizer. The two folding arms are hydraulically controlled to change from a transport position that is three meters to the working position. The work units for all three double furrows are practically the same. Medium is firmly connected to the frame and allows copying of the plot in the vertical plane. Two side units are mounted on slide system on the frame. They can independently move horizontally along the frame in the 0.4 meter range. Their current position for a given double-row is determined by an ultrasonic transmitter that responds to their bias from the center furrows. Sensors send a signal to the control unit that moves the outer units over the hydraulic piston rod independently and always optimally so that the working side units are in the correct position. This control system works very accurately and reliably in the range of 4-10 km / h. Each work unit is equipped with star-shaped rollers to break up the soil crust, further bobbing plows for loosening the edges of the rail furrow and the base of the pit. Each unit is equipped with a cultivating wheel with blades for the creation or renewal of dents and dams in the non-rail furrows. A special knife is placed in front of the blade wheel for the application of liquid fertilizers to the plant root zone. Adjustment of the pressure for individual working tools is solved by means of springs. Adjustment is easy and requires no mounting tools. Technical solution of Varior 500 is original and innovative, and therefore some parts of the machine are copyrighted by two patents.



*Note: The view of the Varior 500 design shows the combination of the working position on the left side and the right-side transport position. The transport width of the machine is folded down three meters.*

*Fig. 4: Machine design VARIOR 500 (oblique view).*



*Note: From the ground plan of the machine is visible truss construction of the main frame of the machine. This technical solution safely carries a 500 liter liquid fertilizer tank. Potatoes are mostly grown in the Czech Republic in the highlands in stony soil conditions, so the frame is designed to be sufficiently durable.*

*Fig. 5: Machine design VARIOR 500 (floor plan).*

## 5. Environmental aspects

**Cultivation of potato furrows** at the onset of the crop has a significant environmental benefit due to better retention of precipitation water in the soils, slowing down and limiting its drainage, which has been positively reflected in the reduction of surface contamination and water erosion when growing potatoes on sloping land. Figure 6 compares the loss of soil after a rain simulator of the roots in the intersection with the intermittent intake groove + denting the non-drive furrow as compared to the conventional shape of the furrows (variant Conventional) and with cultivation of the furrows + dam the non-drive furrows prior to emergence. The irrigation of simulator and subsequent measurements were carried out 2 x 20 minutes consecutively with a total of 2 x 24 mm precipitation on the soil with natural moisture and on the soil saturated after the first irrigation according to the methodology of VÚMOP v.v.i. Other results and knowledge about the effect of the cultivation of the furrows on rainfall of precipitation water are described in detail in the attached peer-reviewed publication.

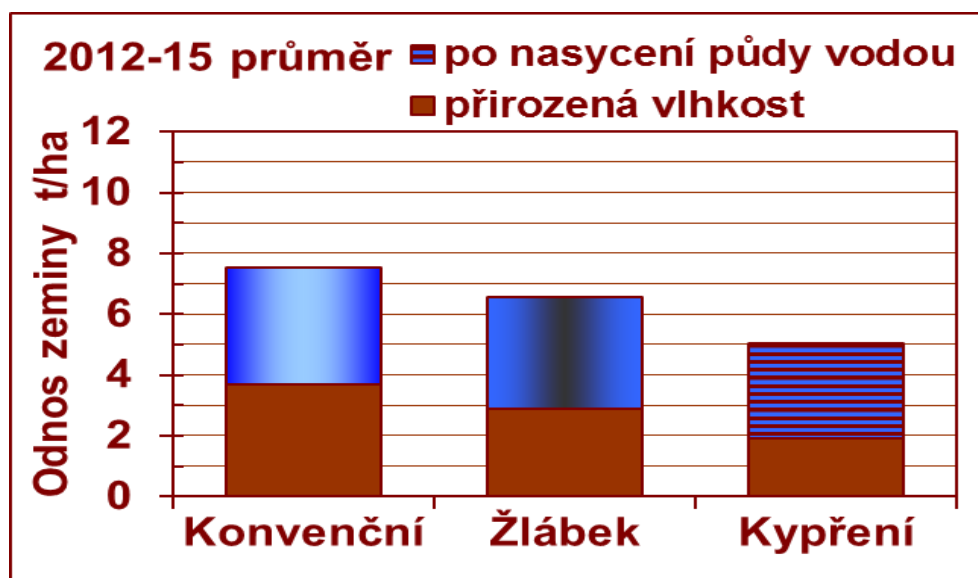


Fig. 6: Positive influence of the cultivation of furrows on the reduction of loss soil after intense precipitation (Věž, 2012-2015).

**Water absorption from rainfall or irrigation** - The period from potato planting to the full growth is very critical from the perspective of water erosion on sloping land. Frequent rainfall of varying intensity can cause crusting on the surface of the furrows, floating fine parts of non-structural soil into the wells and grooves created during the planting, which reduces the retention capacity of the treated rows and furrows. The cultivator breaks up the crust on the surface of the furrows at the beginning, creates or restores the dents and dams in the non-tramline rows, and, by means of wheel with blades, disturbs the compacted layer of soil after the machine passes on the edges of the furrows, thereby increasing the retention of water from rainfall or irrigation (Fig. 7).



Fig. 7: Influence of Varior 500 on surface drainage of water absorption in the rain in cultivated furrows (left) and without cultivation (right) furrows.

**Application of fertilizers before growth into the root zone of plants** - As a part of the cultivator, is the liquid mineral fertilizer application equipment is an original method of fertilization using special application chisels (blades) from the bottom of the non-tramline furrow to the root zone of the potato, followed by the formation of dents and dams in the furrow from where the retained water from rainfall or irrigation is directed to the roots of plants where is applied fertilizers. Fertilizing potatoes at the beginning of vegetation to tuber roots, compared to fertilization before or during planting, significantly reduces the risk of nutrient loss (especially nitrate and sulphate by washout) and increases the use of nutrients from applied fertilizers by plants. Reducing the risk of nitrate pollution in potato growing on sloping soils has a significant environmental benefit (Fig. 8).



Fig. 8: Application of fertilizers before growth into the root zone of plants by machine VARIOR 500.



## 6. User comfort and readiness of Varior 500 for supplies to the Czech and foreign market

Serial production of the VARIOR 500 cultivator as well as warranty and post-warranty service will be start by P & L in 2018. Part of the sale is operator training including work safety. Deliveries of the product (at least 2 pieces) to the Czech potato market will be carried out already during this spring season. For cultivation of potatoes on slightly sloping land, there are currently no suitable machines and technologies in the Czech Republic which the soil protection requirements acceptable in DZES 5 (Decree of the Ministry of Agriculture). The purchase of new cultivators of RDP subsidies is envisaged.

## 7. Technical specification

Table 1: Technical specifications of the VARIOR 500.

Technical specifications	Model
	VARIOR 500
Lenght	2 600 mm
Working width	5 920 mm
Transport width	3 000 mm
Transport height	3 000 mm
Weight without a tank	1 100 kg
Weight with full a tank	1 410-2050 kg
Working speed	4–10 km/h
Tractor power	90–120 HP

## 8. Presentation of the exhibit in terms of its use and deployment in practice

The VARIOR cultivator has been vivificate in the years 2012-2017 in the pilot plant trials on the ZAS Věž, a.s. The final version of the exhibit was successfully verified in 2017 for more than 100 hectares in agricultural companies ZAS Věž, a.s., ZD Vysočina Želiv and the demonstration farm of the Ministry of Agriculture of the Czech Republic VESA Česká Bělá. It is clear from the results obtained (see the peer-reviewed publication in the appendix) that the cultivation of the furrows at the beginning of the potato growth has had a beneficial effect on the retention of water from precipitation in the furrows, reducing the risk of water erosion and increasing the yields of the tubers. For those farmers in agricultural practice, the cultivator was presented in the form of expert publications in Úroda magazine and in the P & L newspaper. At the same time during 2017, during the field days organized on the demonstration farms of the Ministry of Agriculture of the Czech Republic in VESA Česká Bělá and Vysočina Janovice, and at least 10 professional seminars and workshops, some of which were organized in cooperation with the Central Potato Union of the Czech Republic (Chloustník, Čelákovice, Lukavec, Horažďovice, Havlíčkova Borová, Havlíčkův Brod and others).

## **Attachments**

### **Annex 1: Operating manual and machine safety**



## **Annex 2: Expert article**



### Annex 3: Development and verification of the machine in cooperation with partners

*The VARIOR 500 has been developed and verified in collaboration with the partners listed below.*



VÝZKUMNÝ ÚSTAV  
BRAMBORÁŘSKÝ  
Havlíčkův Brod, s. r. o.



Výzkumný ústav meliorací  
a ochrany půdy, v.v.i.



MINISTERSTVO ZEMĚDĚLSTVÍ  
ČESKÉ REPUBLIKY

## Annex 4: List of pictures, tables and abbreviations

### Pictures

Fig. 1: *Varior 500 Potato Cultivator (autumn 2017).*

Fig. 2: *Machine work units VARIOR 500.*

Fig. 3: *Machine work units VARIOR 500 during cultivation.*

Fig. 4: *Machine design VARIOR 500 (oblique view).*

Fig. 5: *Machine design VARIOR 500 (floor plan).*

Fig. 6: *Positive influence of the cultivation of furrows on the reduction of loss soil after intense precipitation (Věž, 2012–2015).*

Fig. 7: *Influence of Varior 500 on surface drainage of water absorption in the rain in cultivated furrows (left) and without cultivation (right) furrows.*

Fig. 8: *Application of fertilizers before growth into the root zone of plants by machine VARIOR 500.*

### Tables

Table 1: *Technical specifications of the VARIOR 500.*

### Abbreviations

*a.s. - joint-stock company*

*CRI - Crop Research Institute Prague, Public Research Institution*

*DZES - Standards of good agricultural and environmental condition of land*

*EU - European Union*

*NAZV - National Agency for Agricultural Research, Ministry of Agriculture of the Czech Republic*

*P&L - P&L, spol. s r. o., Biskupice 206, 763 41 Biskupice u Luhačovic*

*PRI - Potato Research Institute Havlíčkův Brod, s.r.o.*

*RDP - Rural Development Programme*

*s.r.o. - Ltd. (Limited company)*

*TACR - Technology Agency of the Czech Republic*

*ZD - agricultural cooperative*

## **Annex 5: Declaration of Conformity**



## **Annex 6: Video Presentation**



## **Annex 7: Machine leaflet**

