GRAND PRIX TECHAGRO 2018

Presentation of the exhibit of the company

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

Eco Tiller 600

Machine for Strip Till technologies with application of digestate, mineral fertilizer or sowing

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

Czech Republic

The product competes in a special category

Soil Water Retention Friendly

www.pal.cz

Content

Eco Tiller 600 – technology for the cultivation in the strips (Strip Till)

1. Machine characteristics

Eco Tiller 600 machine for Strip Tillage has great economic benefit. On the same working width consumes significantly less fuel compared to conventional soil preparation at the same depth (Figure 1). A great benefit is also ecological. Strip till technology maintains a better water regime in the soil. The soil does not dry out so much because of its processing is only in strips. A strong anti-erosion effect of this technology is demonstrated on slightly sloping land for corn, sunflower and others. Eco Tiller 600 is characterized by a massive construction of the frame and working units. Working units are constructed for conditions with large amounts of residues after harvest. The machine can be used for slurry or digestate application into two different depths and different dose or for mineral fertilizers application or crops seeding. Eco Tiller 600 was developed and verified in cooperation with Research Institute for Soil and Water Conservation (RISWC) Prague, Crop Research Innstitute (CRI) Prague - Grassland Research Station (GRS) Jevíčko and with the support of the Ministry of Agriculture of the Czech Republic - NAZV QJ1510179.

This technology can be characterized as a combination of reduction of soil drying and the benefits of soil warming - the advantages of classical soil cultivation in the system of soil protection technologies, with the aim of creating optimum conditions for seed growth.

Fig. 1: Eco Tiller 600 for soil treatment (autumn 2017).

2. Advantages of the design solution

The great advantage of the Eco Tiller 600 is its own original design solution. The support frame is made up of a truss structure that exhibits a higher strength compared to the construction of the central single profile frame used by European manufacturers. Also, the length of the work unit is larger than the EU producers. The reason is two pairs of cleansing fingers (the competition uses one pair), which work better in mulch. The unit is designed to

work on permanent grasslands, as well as in the conditions with thick layer of straw after harvest of maize. If a user needs the machine primarily for digestate application, he can choose a shorter version of a work unit with up to three application points at different depths with a row spacing of 0.75-0.45 meters. Eco Tiller with a shorter working unit is designed for aggregation with a tank applicator or a self-propelled tank.

Scheme of the support frame, which is made up of truss construction (Figure 2). This allows the installation of units with rows in the range of 75-45 cm. On the central truss frame is a complete hydraulic system of the machine, a three-point hinge of category 3, and there is enough space to hold the cutting and distribution head for the digestate, the splitter head for the granulated fertilizer or the seed hopper container.

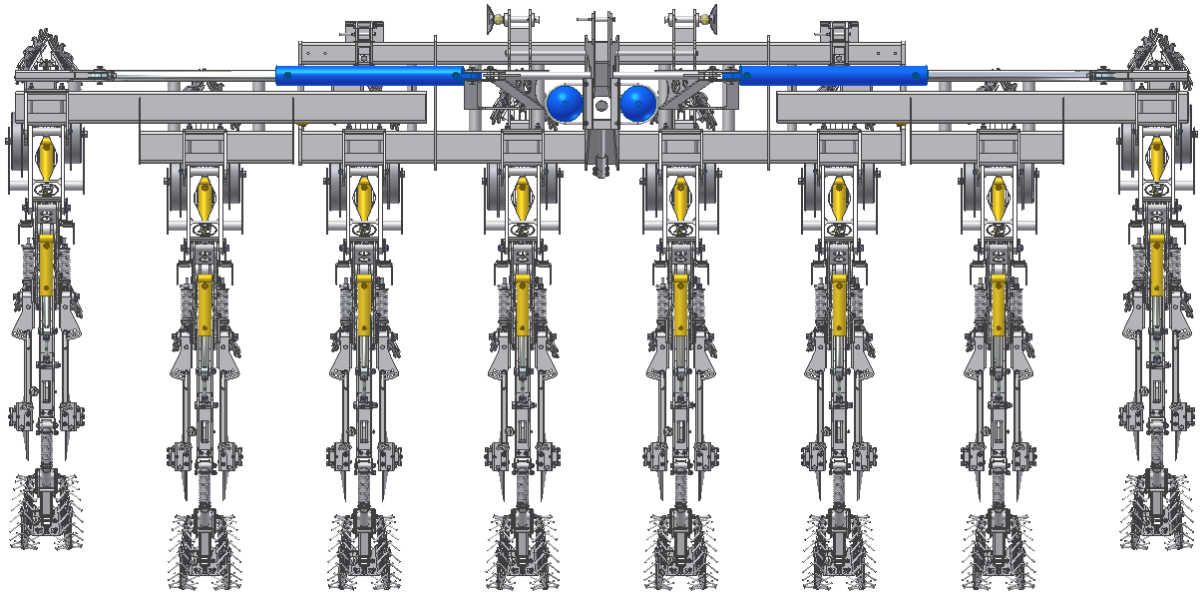
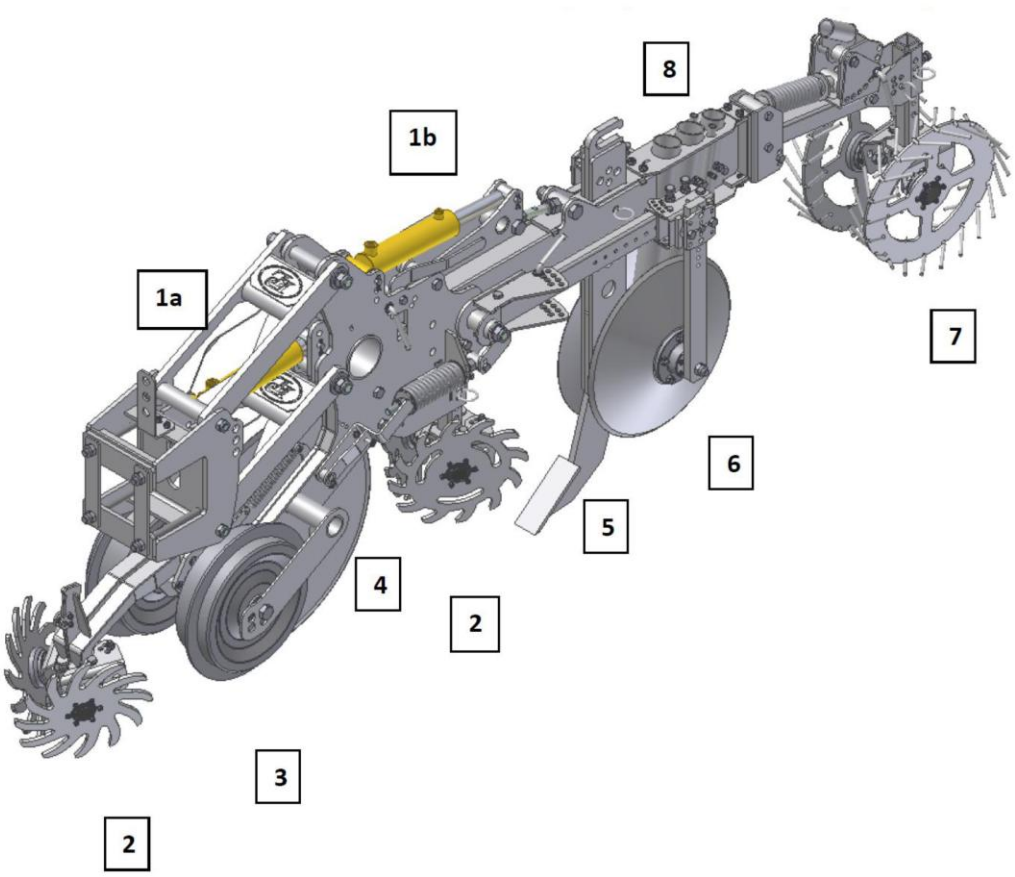


Fig. 2: Machine supporting frame Eco Tiller 600 with work units.

3. Work unit and its technical solution

The unit is mounted on the frame via a parallelogram (Figure 3). The working pressure, as well as the overload protection, is solved by a hydraulic system. For precise work in large quantities of harvest residues, the unit has two pairs of finger cleaner whiles, and the first pair can be just option for the customers. Eco Tiller is designed for working on permanent grassland or grassland on plowing land. For this reason, the machine is equipped not only with a central large coulter, but also with coulters on field wheels, which cut the processed strip on the sides to avoid lateral soil tearing. The work unit offers up to three application locations:

- digestate or slurry,
- mineral fertilizers in liquid or granular form,
- the possibility of sowing sub-crops or rape and other crops.



Description: ***1a*** *- hydraulic piston rod with pressure function - harallelogram and change from transport to working position;* ***1b*** *- hydraulic piston rod with overload protection function - contact with stones, etc.;* ***2*** *- two pairs of finger wheels cleansing to remove plant residues from the treated strip of soil /under conditions with a small amount of plant residue alternatively without the first pair of cleaning wheel/;* ***3*** *- two support wheels with cutting ring - suitable for permanent grassland /alternatively smooth PNEU FLEX support wheel/;* ***4*** *- central coulter with a diameter of 570x6 mm;* ***5*** *- big shank, easy to adjust for soil depth up to 30 cm /different types of removable work tools can be used/;* ***6*** *- concave shaping discs with a diameter of 430 mm for modulation of the final profile of the treated strip of soil /alternatively, smooth coulter, or curled discs - coulter with bald can be used/;* ***7*** *- crumbling wheel "V" produces soil structure /alternatively, the PNEU FLEX and other versions/;* ***8*** *- three lines for application of different types of mineral fertilizers in liquid or granular form, application of digestate, slurry, all at the same time at different depths in the soil*

Fig. 3: Eco Tiller 600 working unit.

The concept of the work unit is designed so that the user can choose individual parts of the machine to suit the given conditions. It is about:

- cleaning wheels,
- cutting discs,
- side discs for modulation,
- crumble and press wheel.

The adjustment of the individual parts of the work unit is designed so that basic machine settings can be made with the change of soil (Figure 4) and climatic conditions practically without the need for assembly tools.


Fig. 4: Tiller 600 when working on stubble after harvesting cereals (autumn 2017).

4. Ecological aspects of the machine

The **Eco Tiller 600** has significant environmental benefits in the following areas:

- lower fuel consumption and lower tractor power demands per unit area - less emissions from the engine;
- technology eliminates water erosion of soil on sloping land (*for details see part 4.1*);
- technology better exploits soil moisture, no soil drying compared to classical technology;
- lower CO_2 emissions compared to plowing technology;
- technology is more environmentally friendly and better manage organic matter in soil;
- technology eliminates the compaction of frequent crossings on land (soil compaction);
- the application of organic fertilizer (digestate) to soil is more effective to plant growth and more environmentally friendly.

4.1. Limitation of water erosion and water retention in soil

The significant benefit of Strip Till technology would be demonstrated in soil protection against water erosion in wide rows crops. The higher penetration capacity of the soil in this case is due not only to a better soil structure in the cultivate strips but also by leaving the plant residues in the interrow place, see Figures 5-7.

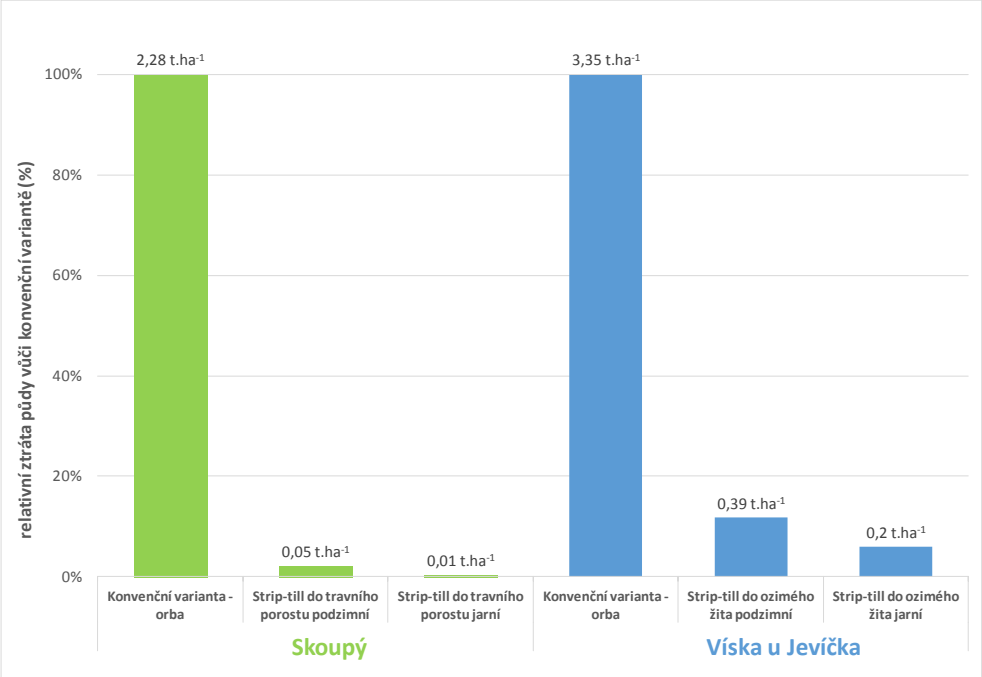


Fig. 5: Average loss of soil by water erosion during simulation on naturally dry soil in the period 2015-2017 (source RISWC Prague).

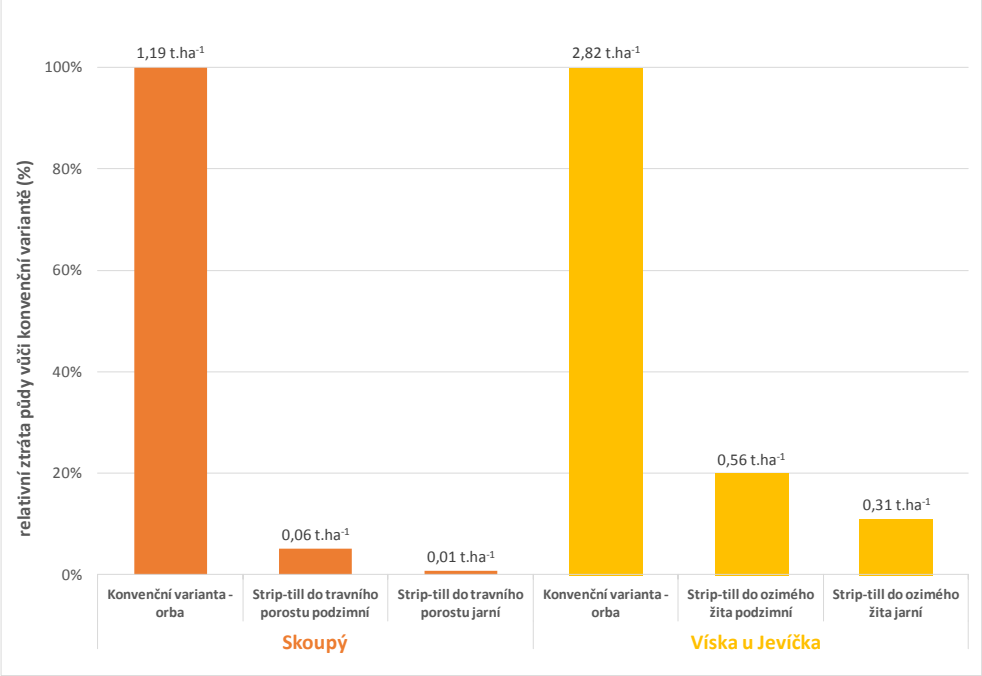


Fig. 6: Average loss of soil by water erosion during simulation on wet soil in the period 2015-2017 (source RISWC Prague).

Fig. 7: Rain simulator in action at Jevíčko 2016 (RISWC Prague).

This technology directly encourages a large use of cover crop technology based quickly after harvesting and Strip Till autumn (Figure 8, 9) or spring Strip Till soil with Eco Tiller for corn, sugar beet and other crops. This process reliably and naturally delivers organic matter to the soil, the content of which in the soil is reduced in the long term due to changes in crop rotation.

Note: The Eco Tiller 600 has been designed for to make furrow soil strips for spring corn. The soil gradually freezes during the winter, gets down and in the spring the processed strips are prepared for the corn planted by a no-till planter.

Fig. 8: Pilot experiment at locality Víska u Jevíčka (CRI Prague - GRS Jevíčko, autumn 2016).

Note: When processing post-harvest grain maize residues it is necessary to have the machine equipped with two pairs of cleaning fingers whiles.

Fig. 9: The work of the Eco Tiller on the plot after the harvest of grain maize with a large amount of plant residues on the surface (Vážany, AGROSPOL Knínice, CRI Prague - GRS Jevíčko, autumn 2016).

5. Novelty and Economic benefits of the machine

The Eco Tiller 600 is the first of its kind technology among Central and Eastern European producers. And in the sense that there are work units on the machine that have been designed and tested for strip cultivation as a priority. Thus, this is not a general arrangement of a classical machine for vertical cultivation of the soil or the adjustment of a conventional cultivator. The work unit has clear features of its own solution and the original design conception of some parts. For example, a double acting piston rod has been selected for the unit's pressure, which forces the work unit to reach the machine frame in one position for easy transport of the machine (up to three meters) on the roads, and in the opposite position determines the working pressure. In the construction of the slurry, emphasis was placed on the fact that the treated soil strip was of comparable quality to the cultivated soil by a conventional cultivator. The user does not have to worry that the machine processes the soil at a lower level than normal practice in conventional technology.

The economic benefit is to be seen primarily in the "tractor power" saving, ie in the lower energy intensity per unit at the same depth of soil treatment, as compared to the machining of the entire soil profile. Depending on the setting of the Eco Tiller work units, it is usually about one-third of the area of the plot. Therefore, the unprocessed part of the plot area should be at least 60%.

6. User comfort and readiness the machine for deliveries to the Czech market

The production of Eco Tiller 600 as well as after-sale service will be start by P & L in 2018. Part of the sale includes operator training including work safety. For the 2018/2019 season, it is planned to produce 10-12 pieces of this machine, half of it will befor digestate application. The technology of Strip Till technology is included among the recommended practices meeting the soil protection requirements acceptable in the DZES erosion decree 5.

The work unit of the machine is designed so that most of the settings that the operator may need in practice can be handled without the mounting tool. Safety of the machine is described in the operating instructions. P & L provides after-sale service within the Czech Republic and abroad in accordance with the law and practice for serious business service companies.

7. Technical specification

Table 1: Technical specifications of the Eco Tiller 600 and 450.

Technical specification	Model	
	Eco Tiller 600	Eco Tiller 450
Lenght	2700 mm	2700 mm
Working width	5650 mm	4350 mm
Transport width	3000 mm	3000 mm
Transport height	2540 mm	2540 mm
Weight	3050 kg	2550 kg
Working speed	8–12 km/h	8–12 km/h
Tractor power	25–35 HP/row	25–35 HP/row
Working depth	150–330 mm	150–330 mm

8. Validated research results - certified methodology

The technology of Strip Till processing which Eco Tiller 600 is using is described in a certified methodology issued by the CRI Prague in cooperation with RISWC Prague in 2017, entitled „Establishment of maize into grasslands on arable land using soil conservation technology by strip tillage“, authors Pavel Nerušil, David Kincl and colleagues. The results of the research are described in the Nerušil et al. (2017) and other scientific publications were carried out using the Eco Tiller 600 machine, the development team of which was supported by the Ministry of Agriculture of the Czech Republic - NAZV No. QJ1510179 and developed in the period 2015-2018.

Attachments

Annex 1: Certified methodology

NERUŠIL, P. - KINCL, D. - MENŠÍK, L. - SRBEK, J. - PROCHÁZKOVÁ, E. - KOBZOVÁ, D. - ŠEDEK, A. - HEROUT, M. - JURKA, M. - VACH, M. Establishment of maize into grasslands on arable land using soil conservation technology by strip tillage. Crop Research Institute, Praha, 2017. 32 s. (In Czech)

Annex 2: Expert article

KINCL, D. - ŠEDEK A. Development tools for strip tillage in domestic conditions. Úroda 12/2017, Praha, s. 42–44. ISSN: 0139-6013. (in Czech)

Annex 3: Operating manual

The materials are part of the submitted forms.

Annex 4: Machine development within the framework of the MZe project NAZV QUS1510179

The Eco Tiller 600 was developed and tested within the project

MZe NAZV KUS QJ1510179

"Complex No Till Technologies cultivation for Zea mays L. in the context of the reintroduction of plant production"

Program

Comprehensive Sustainable Systems in Agriculture 2012-2018 "CSS"

Subprogram

Sustainable agricultural systems

Machine name:

Eco Tiller 600 machine for cultivation soil in strips - Strip Till

Research Institute for Soil and Water Conservation, Prague (Ing. D. Kincl, Ing. J. Srbek)

Crop Research Institute Prague - GRS Jevíčko (Ing. P. Nerušil, Ph.D., Ing. L. Menšík, Ph.D.)

ZD Krásná hora nad Vltavou, a.s (Ing. M. Herout)

P&L, spol. s r.o. Biskupice (Ing. A. Šedek)

Hanácká zemědělská společnost Jevíčko, a.s. (Ing. M. Jurka)

MINISTERSTVO ZEMĚDĚLSTVÍ ČESKÉ REPUBLIKY

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

Výzkumný ústav rostlinné výroby, v.v.i. PRAHA - RUZYNĚ

ZD Krásná Hora nad Vltavou a.s.

P & L, spol. s r.o.

JEVÍČKO

Annex 5: List of pictures, tables and abbreviations

Pictures

Tables

Abbreviations

a.s. - joint-stock company
CO_2 - carbon dioxide
CRI - Crop Research Innstitute Prague, Public Research Institution
DZES - Standards of good agricultural and environmental condition of land
EU - European Union
GRS - Grassland Research Station Jevíčko
MZe - Ministry of Agriculture of the Czech Republic
NAZV - National Agency for Agricultural Research, Ministry of Agriculture of the Czech Republic
RISWC - Research Institute for Soil and Water Conservation Prague, Public Research Institution
spol. s r.o. - Ltd.
ZD - agricultural cooperative

Annex 6: Declaration of Conformity

Annex 7: Video Presentation

Annex 8: Machine leaflet