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Technology

Machinery of territorial impact

Biomimetics Applied to Agricultural Machinery



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#Biomimetics #efficiency #energy #adhesion #machinery #agricultural #surface
#nanotechnology #soil #topography #energy #traction force

<https://www.argentina.gob.ar/inta/tecnologias/superficie-biomimetica-aplicada-la-maquinaria-agricola>

The adhesion of the soil to metal surfaces of agricultural machinery increases tillage resistance and causes greater power consumption and lower quality of the work performed. This technological proposal solves such problem: it substantially reduces the tractive force, which positively impacts power efficiency, fuel consumption and labor time. It expands the time window to perform tasks, since it enables to work with different moisture values in the soil.

Researchers from the Rural Engineering Institute of Argentina developed an alternative technology that consists in designing the surface of the working parts of agricultural machinery based on biomimetic principles. In this case in particular, the design is inspired by the cuticle of the thorax of the female *Diloboderus abderus*.

The fundamental principle underlying this idea is redesigning the surface of the working part that interacts with the soil with a biomimetic criterion. Based on this modified surface, a new topography appears on such part, with cavities laid out in a hexagonal pattern whose morphological unit is an equilateral triangle. This change delivers non-adhesion and self-cleaning surfaces, which in an absolutely novel concept in the agricultural sector, since it reduces the adhesion of soil to the metal surfaces.

The relation between the soil and the tillage tools includes an essential component known as mechanical strength, which conditions the ease of soil tillage. This relation is defined by two properties, adhesion and friction. Adhesion is described as the attraction force that resists the soil slippage on the metal surface. Texture is a relevant factor. At greater clay particle ratios, the greater the adhesion. Friction refers to the soil-metal friction magnitude and mainly depends on the degree of tool polishing.

The classic theory states that the more polished the tool is, the less friction and, consequently, the greater the power efficiency. As adhesion increases, soil-soil friction occurs, which increases power demand. The above-mentioned properties of the biomimetic surface reduce adhesion and replaces soil-soil friction with soil-metal friction of lesser magnitude. Thus, the tool slippage resistance drops, which results in lower tractive force requirements and higher power efficiency with the subsequent energy, fuel and time savings.

This technology may be applied broadly in different working parts of agricultural machinery, from the furrow openers on seeders to the plough discs. The solution would be of great benefit for agroindustry and farmers, enabling them to offer products developed with last-generation technology. Others would experience the highly positive impact on their income, since it reduces fuel consumption, with an almost 30% incidence on the cost of agricultural machinery. On the other hand, in small scale economies that depend on animal traction tools, the use of power is critical. In this sense, by adopting this modification, agricultural machinery improves farming efficiency and covers a more extensive area in a day.

1. It reduces traction force demand by 7%, which impacts energy efficiency in tillage and, consequently, fuel and time savings.
2. It is an environmentally friendly technology, since it promotes energy efficiency that reduces greenhouse gas emissions (GHG). It also contributes to two relevant areas: rational fuel use and sustainable soil management.

3. It is applicable not only to the working parts of agricultural machinery that operate in contact with the soil, but also to equipment used in other productive activities.

4. Beneficial to small farmers who rely on animal traction tools as their source of power.

- Patent title: Modified surface topography for an agricultural tool. Patent No. US9.137.937A2 granted by the United States Patent and Trademark Office (USPTO)

- Title of the invention: *FERRAMENTA AGRICOLA* N/Ref.: 432 - 2443 BR granted by the Brazilian Patent Office (INPI, as per the Portuguese acronym). Patent No. BR 102013026703-1

- Title of the invention: Surface topography of agricultural machinery tools that interact with the soil and agricultural tool with modified surface topography

Patent No. AR093034B1 granted by the National Patent Office of the National Industrial Property Institute (INPI, as per the Spanish acronym) of Argentina.

<https://youtu.be/3kQfs-Qarvw>