MECHANIZATION OF CONSERVATION AGRICULTURE IN BRAZIL – AN OVERVIEW

Augusto Guilherme de Araújo and Ruy Casão Junior
Agricultural Research Institute of Parana State – IAPAR
agaraujo@iapar.br
Brazil

The expansion of no-tillage in Brazil in the last decades has been followed by the development of new agricultural machinery made by national industries with appropriate designs for different soil and climate conditions of the country. The no-tillage seeder was the machinery that suffered most adaptations and investments in new designs over the last 25 years in Brazil. Currently, the country has more than 30 industries, of medium and large sizes, focused on this sector with more than 300 models spanning different cultures and seed distribution systems.

The expansion of large farms in the Brazilian flat Cerrado soils (central-western region) generated the need for machines with large number of lines or units of seeding. In the South, the most common models were predominantly 7 to 9 lines and in the Cerrado ranged from 11 to 19, with some models reaching 29 lines spaced at 45 cm.

In recent years , the autonomy of the fertilizer hopper that used to allow distances about 10 km increased to 20 to 30 km raising the weight of the machine from 294 kg 778 kg per line. Consequently there was an increase in tractor power requirement and soil disturbance.

Furthermore, in Cerrado the soils are, in general, lighter than the clay south and therefore predominates the offset double-disc opener as component for soil opening for fertilizer placement, which requires less power and reduce soil disturbance in relation to tine type opener, more commonly used in clay soils in the south. Beyond less power requirement, the double-disc incorporates less mulch into the soil and allows operation at speeds higher than 6 km/h. However, when the double-disc doesn´t operate properly and by consequence the furrow results too shallow there is a risk that seeds remain close to the fertilizer, which impairs germination.

Other option of soil opening for fertilizer placement is the tine, which requires greater power but allows a better adjustment of the groove depth and fertilizer placement below the seeds providing a more suitable condition for germination.

Presented during OSCAR Meeting in Viterbo, Italy, 3-6, June, 2013.

IAPAR recommends narrow tine openers with tip width not exceeding 22 mm, rake angle of 20° and parabolic shape, which require less power traction, results in less soil disturbance, incorporate less mulch and in some cases, presents a component of vertical force downwards, which helps for soil penetration and reduces the seeder weight.

The weight of commercial no-till seeders in Brazil ranges from 294 kg to 778 kg per unit of seeding (line), without charge, for models with 7 to 24 rows spaced at 45 cm.

The seed metering system for precision seeders is still predominantly mechanical with horizontal plate but the use of pneumatic systems is increasing mainly because it promotes more uniform distribution of seeds at speeds greater than 8km/h. The obstacles for expansion of the pneumatic system are it´s high price (about 20% more expensive than mechanical models) and it´s limitation for cutting mulch, furrowing and proper covering the seeds at speeds exceeding 6 km/h.

For medium farms in the South region, the precision seeders follow the same trend of the machines used in Cerrado, namely an upward trend in the number of seeding lines (under certain limitations due to the small size of the crop land) and in the size of fertilizer hoppers.

For the fertilizer metering system, the most commonly device is the auger-feed that has been improved for better uniformity, ease maintenance and durability.

Another innovation incorporated into the direct seeders in the last years was the quick gear change for both metering systems which ensured greater efficiency and quality in this setting.

A very important aspect that has gained attention of manufacturers is the ease of maintenance of the machine. In many models still predominates ball bearings with grease fittings but the use of shielded bearings, which don´t require maintenance, is increasing. It is common to find up to 13 lubrication fittings points on a single seeding line although there are also machines with only one lubrication point per unit seeder. There are machines with lO lines and more than 200 points of lubrication and for this reason the search for easy maintenance and adjustment of the seeder has been a concern of industries.

The smooth cutting disc is the most common type of mulch cutting component used in no-till seeders in Brazil. In the past, it allowed only changing the pressure of the springs but currently it also can be

positioned at different heights. The same had occurred with tine, double-disc for deposition of seeds and press wheels.

However, furrow covering with soil and mulch is an important function of no-till seeders which is not receiving enough attention from the designers. These components are important not only to close the groove with soil but also to return the mulch displaced by other components of the seeder once it is recommended to keep mulch on the furrow surface.

In Brazil, the greatest problem during a precision seeder adjustment is to change the line spacing because it´s a very laborious task. The design of new components to become this operation easier would make possible the seeding of cover crops between corn or sorghum and other practices of integrating farming with livestock.

Another frequent problem related with precision seeders is the occurrence of clogging which is the residue accumulation between soil components of two neighboring lines of the seeder. To minimize the problem, many industries have made the seeder structure higher, offset soil components and increased the distance between components. But the problem has returned along with the tendency of increasing seeder weight leading to wait for mulch drying or even requiring a chemical or mechanical management prior seeding.

In terracing areas, it is common for no-till seeders to operate diagonally to the slope to cross these structures during the operation or to seed over the wide base terraces. In the latter case, many seeders do not have the required articulation to keep all components in contact with the soil and ensure a good seeding operation. In recent years, new equipment has been appeared on the market to solve this problem.

Management of cover crops and crop residues

In many high temperatures sites of Brazil, the decomposition of organic matter takes place very quickly by reducing the beneficial effects of maintaining the mulch over the soil surface. For this reason, if the cover is crushed by a crusher or shredder, for example, there will be a greater contact surface available for action of micro-organisms and therefore the residue decomposition becomes faster.

The knife-roller has proven to be a good alternative for management of cover crops and residues because they are cut into large pieces and the rate of decomposition are reduced.

When the cover crop is a grass, the plants die easily along the milk stage even when their stems are just crushed without requiring to be cut completely.

Legumes plants can be managed during its flowering stage but it's necessary to cut off the plant. Studies of IAPAR had showed that at least 450 kgfm of energy is required to manage a cover crop resulting in 30% and 70% of cutting and crushing the plant, respectively, and for total cutting it is necessary 600 kgfm.

It is noteworthy that the greater the distance between the knives, the greater should be the weight and diameter of the roller, resulting in greater kinetic energy of the knives to impact the cover crop mass. Sharpening of knives as well as control the speed of operation are essential aspects to get a good performance of the knife roller.

The impact energy increases with speed but speeds above 8 km/h result the same effect of a wheel passing over the cover crop without cutting it properly. By the other side, weight in excess may result in deep penetration of the knife into the soil.

IAPAR recommended that a knife roller should has a diameter of 600 mm, knife height of 100 mm and 10 knives sharpened with 25° bevel. The body of the roller can be divided into three sections for partial or total filling with water thus providing more or less impact energy.