AN INNOVATIVE TOOL FOR IN-ROW CULTIVATION

Cristian IACOMI, Octavian POPESCU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăști Blvd.,
District 1, 011464, Bucharest, Romania

Corresponding author email: cristian.iacomi@yahoo.co.uk

Abstract

In-row cultivation is the last piece in effective non-chemical weed control on a farm. In many ways, cultivation is the ‘crown jewel’; it is where the skill, ability, observation and timing of a good operator makes or breaks the effort (much more so than the choice of any particular piece of equipment). Successful weed control is the sum of all operations and cultural management. The purpose of the cultural methods (crop rotation, soil fertility management, sanitation, good seed, cover crops, etc.) and early season weed control (so-called blind cultivation) is to achieve the greatest possible crop-weed size differential, especially when there are many hectares to be cultivated. The last stage, in-row cultivation, is the final performance in the whole package of weed control strategies. This paper presents an innovative new tool of an in-row cultivator, a new combination between classic knives (could be shovels, S-tine teeth, C-shank teeth or Trip-shank teeth also) and a special unit of two vertical mini-discs gangs to improve soil cultivation and weed chopping. Research was carried out in the Department of Mechanisation of the Faculty of Agriculture of the University of Agronomic Sciences and Veterinary Medicine of Bucharest.

Key words: in-row cultivator, knives, mini-disc gang.

INTRODUCTION

From the very start, it is important to consider in-row cultivation as a ‘cleanup’ procedure, not as the primary weed control. Well-timed early weed control is absolutely essential to reduce the size of the weed population before it becomes a threat to the crop. Even with a good job of blind cultivation, there are usually some escapes (weed seeds that get away and resprout), and, especially when wet weather prevents proper timing, there may be lots of escapes. Subsequent in-row cultivation is then necessary to provide clean, productive fields. When it is necessary to in-row cultivate crops that are very small, it is impossible to do a good job on more than a few hectares per day. Weeders allow delaying the first cultivation until the crop is large enough to cultivate deeply and rapidly. Many organic farmers don’t have weedeers, don’t have the right weedeers, or don’t know how to operate them to get optimum weed control.

Cultivation also provides many other beneficial effects far beyond the weeds. Indeed, cultivation is very important for aerating the soil, stimulating crop root growth, conserving soil moisture, and providing insulation from the hot sun with a loose, dry soil mulch.

Few conventional farmers who cultivate their crops spend much time adjusting their cultivators. Herbicides take care of most of the weeds, and skilled cultivator operators are hard to find. Many conventional farmers feel that if they can keep the machine between the rows and avoid taking out too much crop, then they can ‘cultivate’. This careless approach will not work on most quality farms. The real art and skill of cultivating is whether you can also get the weeds within the row without excessively damaging the crop plants.

When the crop rows are clearly visible it is time to begin in-row cultivation. On most grain farms, usually two cultivation passes are required. The first pass is the most critical to determine the season’s weed control, but the second pass is often necessary to eliminate the weeds that were stimulated to grow by the first cultivation, to ‘hill up’ the crop, and to further aerate the soil.

The stage of weeds and weather usually dictate how we time our cultivations. The period of greatest vulnerability for most weeds comes at a different time after planting than that of the crop plants. Because crop seeds are generally large and are planted deeper than most weed seeds, their window of maximum vulnerability mismatches that of the weeds. We have to take
this difference into account when developing weed control strategy. The vulnerability of plants to mechanical disturbance goes through a predictable cycle, starting with a seed that has not yet started to germinate. At that stage, seeds are virtually indestructible by anything other than biological activity. Until a seed gets water and begins to grow, weeders and cultivators have little effect. A seedling is most vulnerable from the time it germinates until after the plant has fully emerged from the soil. The exact timing of these stages varies between species; generally, once plants are past the unifoliate stage, most seedlings are much more difficult to damage. Timing is indeed everything. Unfortunately, knowing the correct timing and being able to move forward are not always the same thing because of challenging weather conditions. Often, by combining the effects of two blind cultivation passes with one to two in-row cultivation passes, we get much more flexibility with sub-optimal conditions (and usually this results in good weed control). It is the timing and skill with which the operations are performed that is most critical, not the number of passes made. If everything else is done right, one to two passes with a row cultivator should be sufficient for good weed control in row crops. Badly timed weedings can actually make the weeds worse. Making a large number of poorly timed or poorly executed passes will result in failure, no matter how many trips are made over the field. It is important to remember that whenever soil is disturbed, a new flush of weeds will be stimulated to germinate. Fortunately, these later weeds are much easier to control, but they still must be considered in the timing of cultivations and weeding operations. Most cultivators built in recent years were not well-designed to control weeds in the row. While it is sometimes possible to do a reasonably good job with a modern rear-mounted cultivator, when the conditions are difficult or weeds are heavy, the shovels next to the row can not be adjusted precisely nor can it be operated close enough to the row to take out the in-row weeds. Front-mounted or belly-mounted cultivators, or pusher cultivators on bi-directional tractors, are far easier to keep on the row and work close enough to the crop plants (they do enter into the so-called protection zone of the row, as closed as it is possible to the plants). The operator needs to be able to easily see all of the cultivator shovels. Carefully watching the soil flowing around the front cultivator shovels and crop plants helps the operator to keep the shovels adjusted precisely where they need to be. It is important to continually adjust speed and down-pressure on the go to respond to variations in soil conditions across the field and to always keep the action of the cultivator as aggressive as possible without excessive crop damage. This is not possible when the operator can’t look at the cultivator while steering the tractor. One of the big problem in Romania is still the old fashion in row cultivator, rear mounted on a tractor, with no way to see behind, this leading to excessive crop damage. There are as many ‘right’ ways to set a cultivator as there are farmers who can get their fields clean of weeds. Every farmer who is good at cultivating develops their own unique combination of equipment, settings and special ‘tricks’ that are especially well-suited to the soils, crops, and conditions found on farm. Two farmers will not do the job exactly alike, yet each one can be a master in his own right. Any new tool which is easing operator work to get a better weed control, which is useful to the soil and which is killing weeds would be of much help in keeping the land clear and in obtaining a good quality crop.

MATERIALS AND METHODS

What is this research proposing is a unique combination of tools to work and cultivate better in between rows. The chassis of an old unit of classic in-row cultivator (provided with knives) was extended, a new part was welded obtaining a longer chassis (Figure 1). Behind knives a unit consisting of two vertical mini-disc gangs were attached. Size and dimensions of discs are shown in Figure 2.
What is worth-mentioned with this unit of mini-discs is the fact that these are not paralleled with the direction of travel but inclined (Figure 5).

This, in our opinion, is giving the cultivator the opportunity to chop better soil and weeds, obtaining a better surface quality. Another worth mentioned fact is that these mini-disc gangs can move laterally independently, covering any working width, which is absolutely unique (Figure 6).

**RESULTS AND DISCUSSIONS**

We were able to develop a new combination of tools for a better in-row cultivation. The unit respects all requirements for buffer (protection) zones and the gangs can be adjusted to any working width for any crop (both agricultural and horticultural crops). Chopping weeds helps in more quickly decomposing them into the soil. Mini-discs gangs are crushing the top layer of the soil and help incorporating the vegetal
residues. Also, behind the gangs we obtain a better, levelled soil surface and a minimum disturbance of plants.

Figure 6. The gangs position are set-off independently

CONCLUSIONS

The main goal of modernizing an in-row cultivator was achieved by building a new solid structure with active working bodies acting different from the classics.

The new bodies which have been developed (mini-disc gangs) are able to work in the vertical plane (like vertical tillage discs) and together with the knives (working in the horizontal plane) are capable to increase the degree of killed weeds and thus having a better control over them.

Shredding and loosening the soil is much better due to new bodies because the distance between discs is just 23 mm, small enough to crush any piece of soil or soil crust, this providing a better cover and protection against water loss.

Since the start of the project we attempted to build a new, perfectly functioning structure, and this was achieved by developing a prototype.

It is perfectly justified that this prototype requires small adjustments in solving problems that can occur during field operations.

Further researches are carrying on optimize the use of this unit and the results will be presented in future papers.

REFERENCES


