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CONSIDERATIONS REGARDING THE CONSTRUCTION AND OPERATION OF AN EQUIPMENT DESIGNED TO MODEL THE SOIL IN COMPARTMENTED FURROWS IN VINEYARDS AND ORCHARDS

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Abstract: Recently, the climate changes have more and more manifested by prolonged draught periods, while population number is continuously growing, therefore the agricultural production per surface unit should be increased, in order to cover the people food needs. View the reduce water resources, promoting new techniques and technologies able to efficiently valorize the water coming from different sources, with reduced energy consume, is very important. In vineyards and orchards, water is conducted along the row or is uniformly stocked by means of continuous or interrupted (compartmented) furrows. This paper aims at analyzing the construction and operating method of a soil modelling equipment in compartmented furrows, simultaneously in two furrows in a single interval, PCVM2,2+EMBC2–0, in tree and vine plantations.
Keywords: water, soil, interrupted furrows

INTRODUCTION

In order to supply additional water quantities (besides those naturally received through rains) to soil, quantities that were established according to soil, climate and plant requirements, and supplementary works are necessary. When establishing the water additional quantity, it should take into account that the soil layer where roots develop keeps an optimum humidity. Having in view the decrease of arable surface comparing to population increment, increasing the agricultural production per surface unit remains the main solution able to meet the many and high–quality food requirements.

In order to achieve high agricultural yields, it should take into consideration a lot of factors (mechanization, fertilization, weed and pest control, soil biological potential, seed quality), each having its importance, but the lack of water in soil, during periods that overlap the plant critical growing phases, diminishes the harvest and even destroys it because of draught.

In Romania, the surface with economic irrigating potential is estimated at 3 million ha, out of which 1.5 mill ha are highly efficient. In this context, irrigations will become the most important consumer of water in agriculture and one of the main national consumers, requiring approximately 35–45% out of Romania water resources. Romania water resources are rather reduced, of about 1660 m3/habitant, and in other European countries they are 2.5 times bigger. Thus, it is very important to promote techniques and technologies able to efficiently valorize water coming from different sources, with reduced energy consume. Water from soil and its circulation is mainly important, as approximately 41% out of Romania arable surface is affected by an excessive humidity in certain periods of the year and during the same year, short or long periods of draught are present; so, the irrigation with variable norms should be applied. At the same time, erosion phenomena are manifested on 35% out of the entire agricultural surface.

Water stock in Romania is rather modest comparing to other countries in Europe (the 11–th place for local resources and 21–st place for resources formed on its territory). [3] Gravity wetting is the oldest irrigation form. Surface drip consists in the fact that water is distributed on the field by free flowing in furrows or stripes concomitantly with water infiltration into soil. Method extended also to hoeing crops sown in stripes or at bigger distances between rows with a minimum slope necessary to free water drip into the furrow. [4]. The opening of interrupted furrows is necessary in the following situations:

- # In unevenness or sloped (that determine the water dripping and stagnation in micro–depressions) fields designed to be irrigated by fixed and mobile spraying installations;
- # In broken relief and little slope fields, non–arranged for irrigation and where the rain water drips rapidly downstream, not being used by plants and determining the erosion phenomenon.

Farmers are interested in preserving soil humidity and, therefore, they searched for appropriate methods to collect and stock a maximum quantity of water in soil, in order to meet the crops requirements. They recognize that during several years, crops yield was limited because of draught in majority of area in the country. Rains fall randomly, so the water quantity does not comply to plants requirements. Majority of rainfalls during the vegetation season happen during great intensity showers. Only a small part of rainfalls infiltrates into the soil, the rest of it provoking excessive drippings and erosion. Thus, a method of collecting rainfall water consists in culture practices, namely creating compartmented furrows. [8]. Little dams are performed by an agricultural machine endowed with working sections, each of them breaking the soil with a chisel, scraping it with a hoe and forming from place to place, at established distances, little dams that gather the rainfall water.. Machine is used in a reduced slope field, in arid or semi–arid areas, where is a shortage of water in crops.

MATERIAL AND METHOD

Irrigation represents an important technological phase in crop plants agro–technology, and also the most important technical mean of eliminating the soil water shortage, constituting the infrastructure of a sustainable development. Technologies of fighting against the climate change effects have importantly evolved through the reduction of water consume for plants (dripping, micro–spraying), high valorization of water by losses diminishing and performing agricultural works such as fertilization, herbicide applying, etc and utilization of other sources of water (wastewater coming from animals or rural, urban and industrial environment). Furrows used in agriculture are extremely important for agricultural production and represent a main component of agricultural ecosystem [5],[6],[7],[8]. It is estimated an increased agricultural production per hectare by 20% for agricultural crops, where interrupted furrows are performed. This is explained by a big quantity of water that infiltrates at plants roots and also by reducing soil erosion. [3].

When performing continuous or interrupted furrows, it is aimed to obtain large sections of furrow necessary to transport and respectively to accumulate a big volume of water. For low–drainage soils, farmers prefer to use alternative furrows.

Figure 1 – Continuous and compartmented furrows after rain

Figure 2 – Alternative furrows [1] [4]

The opening furrow work is named rarefying (soil modelling) and, at first was performed by little plows pulled by animals. Now, this is performed by the machine working in aggregate with a tractor; an equipment designed to perform continuous furrows or an equipment specialized in performing interrupted furrows being mounted on the machine.

The machine equipped to perform continuous furrows comprises small plows performing the furrow triangular section, and modelling devices performing parabolic section and furrow finishing; the machine designed to perform interrupted furrows comprises the main small plows, blade rotors and a mechanism that controls the rotors designed to interrupt the furrows and make small dams (stoppers),; both equipment is mounted on a frame with supporting wheels.

RESULTS

Equipment for soil modelling in compartmented furrows in vine and tree plantations, simultaneously in two furrows in the same space, PCVM2,2+EMBC2–0 (Figure 3) performs compartmented furrows at a distance of 20–40 cm in row, in order to accumulate rainfall water into the soil on which surface the drips fall, thus avoiding the water dripping outside the cultivated area or water accumulation in depressing areas, on sloped fields of up to 5 %, with light, medium or heavy texture soils, ploughed at minimum 250 mm depth, at a humidity close to minimum extreme limit.

Figure 3 – Equipment for soil modelling in compartmented furrows in vine and tree plantations, simultaneously in two furrows in the same space, PCVM2,2+EMBC2–0

Equipment designed to model the soil in compartmented furrows simultaneously in two furrows in vine and tree plantations, PCVM2,2+EMBC2–0 comprises the following sub–assemblies: a left plough body, a right plough body, a device for forming compartmented furrows endowed with control mechanism and optionally, two arrow knives, if concomitant hoeing is desired.

Plough bodies with left and right supports are mounted on plough frame in lateral parts corresponding to ploughing with furrow overthrow to the row inner side, having the distorted body supports to outer frame.

Device to perform compartmented furrows (Figure 4) is formed of following main parts: command mechanism, rotor support, blade rotor and blade pressing mechanism on soil. Adjustment of mechanism designed to compartmented furrows will allow to create soil stoppers along the furrow at distances of 1.5; 3 or 6 m.

Figure 4 – Device of forming compartmented furrows

Mechanism of command (Figure 5) comprises: spur wheel, a transmission system and a driving mechanism.

Figure 5 – Command mechanism

Spur wheeel is metallic and is endowed with steel spurs on the rim aimed at increasing the wheel adherence to soil, avoiding its skidding. The spur wheel should be mounted in a hinged manner at frame central part, being able to vertically oscillate around the spindle that drives the cams, in order to „copy" the field during the working process. For transport position, the spur wheel should be fixed in vertical position.

Transmission is of chain type and aims at transmitting the movement from the spur wheel to the cam wheel spindle. Transmission is made of: support, chain wheels, chain 10 A and protection device.

Driving mechanism (Figure. 6) aims at unlocking the blade rotor in order to form the soil cork on the furrow. Driving mechanism comprises:

- # support of cam spindle– 3 pieces (2 pieces for cams and one piece for spur wheel),
- # cam wheel,
- # lever/cable and locking bolt.

Figure 6 – Driving mechanism

The supports of cam spindle are mounted on rear bar of frame, behind the plough body, and the cam wheel and the lever are mounted on the support. Spur wheel support should be mounted on the bar behind the frame, in central position to the direction of spur wheel.

Cam wheel is made of one disk parallel with the disk with lever role, and cams (1, 2 or 3) are mounted on cam wheel disk, according to distance chosen for creating the soil corks for furrow compartments. Lever is hinged on the support on the direction of cams and has at one end one reel and at the other end one bolt fixing the steel cable. The cable transmits the movement from the lever driven by cam to the bolt locking the blade rotor. The ratchet is made of an axle with a welded plate at its end. Axle slides in two couples represented by two steel thimbles fixed on rotor support. On the axle is mounted a spring that compresses when driving the locking mechanism and helps to lock the blade when driving mechanism does not work. This mechanism has a secure operating without blocking.

Support of the rotor is mounted on the lateral bar of the frame, behind the body. It comprises: a vertical axle, a fork and a bar supporting the spring that presses the blade rotor on soil. The fork is hinged at vertical support and can freely oscillate in vertical plan and supports the blade rotor, the lower end of pressing spring of scraping blade in soil and thimbles guiding the locking ratchet axle. Rotor is made of 4 pentagonal–shaped blades fixed on an axle, the angle between two close blades being of 90^0. The blade has a vertical external side, position that enables the working section to

approach the plant row without harming the plants with the blades.

Pressing spring on soil of scraping blade is mounted by means of a steel rod between the fork supporting the rotor and the bar endowed on vertical support.

CONCLUSIONS

Compartmented furrows are the result of a mechanical work of soil that performs furrows interrupted by soil heaps, at adjustable distances, for forming small basins of accumulated water. During the rainfalls, the excessive water is gathered in these basins so that it could be slowly absorb by the soil, thus removing the dripping outside the cultivated area. This is very important, because during strong showers, the intensity of rainfalls often surpasses the water speed of infiltration.

Experience has demonstrated that wind erosion can be also reduced. In sloped fields, by practicing compartmented furrows, prevention and reduction of water stagnation in low areas of cultivated field, can be achieved. The basins limited by small dams aim at temporarily stock the water coming from rains, (which, otherwise would flow outside the cultivated surface) that will infiltrate into the soil, thus increasing the soil water stock and capitalizing the rainfall water. This practice has been largely adopted due to new irrigation technologies, as well as, to equipment designed to perform compartmented furrows. This equipment performs small dams at 1–2m distance in the furrow. Some cultivators do not open furrows on the path crushed by tractor wheels when applying herbicides or during other agricultural operations.

Note:

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