STATE OF THE ART IN RESEARCH REGARDING TO SEEDLINS PLANTED EQUIPMENT
/
STADIUL ACTUAL AL CERCETARILOR ECHIPAMENTELOR DE PLANTAT PUIETI

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ABSTRACT

The importance of trees in our lives and the environment is invaluable. Unfortunately, the life cycle of these trees is limited by the destructive footing of nature, people, the economic environment, etc., which is why planting saplings is a necessity. This is normally done with specialized planting equipment that replaces manual planting, leading to an increase in planting speed and economic yield. In this paper there are presented some aspects regarding the constructive solutions of planting saplings currently used for afforestation, forest protection curtains, tree nurseries, etc.

REZUMAT

Importanta copacilor in viata noastra si a mediului inconjurator este nepreţuită. Din păcate, ciclul de viaţă al acestor copaci este limitat de foţa distructivă a naturii. Oamenilor, mediul economic, etc., fapt pentru care plantarea puietilor reprezintă o necessitate. Acesta se realizează în mod normal cu ajutorul unor echipamente specializate de plantat care înlocuiasc plantatul manual, conducând la o crestere a vitezei de plantare si a randamentului din punct de vedere economic. In această lucrare se prezintă câteva aspect privind soluţiile constructive de echipamente de plantat puieti folosite in prezent pentru impaduriri, perdele forestiere de protectie. pepiniere de pomi. etc.

INTRODUCTION

The forest is an extremely complex structure with an essential activity in the regeneration of nature, it contributing alongside the seas and oceans to maintaining atmospheric gases in a life-friendly proportions. Thus, one hectare of forest fixes annually between 6 to 10 tons of carbon dioxide and releases between 12-20 tons of oxygen and essential oils which are beneficial to the human and animal respiratory system. Forests have an environmental role in environmental protection, so 50% of Romania's forests are classified as water, soil and climate protection categories. Under the natural conditions specific to our country, the main cause that generated much of the degraded land is the massive reduction of the surfaces. (Almasan et al.. 1981; Draghia et al.. 2010). To this is added the inadequate use of large areas of land after removing the protective shield of the forest. All these aspects, taken as a whole, led to the adoption of national strategies harmoniously framed in the global and European strategies, for the rehabilitation of the forest fund for the sustainable management of forests.

Thus, in our country after 1989 the forest fund has undergone important changes due to the massive and uncontrolled cuts of the forests that led to erosion and landslides, the increase of the flood danger. In order to prevent this situation, the measures that can be taken in this respect are the forestation and reforestation in the medium and long term of the forest land. Currently, the total area of Romania's national forest fund is approximately of 6.5 thousand hectares. Areas covered by forests account for over 97% of the national forest fund. The distribution of forests on relief forms is the following: mountain 59.70%. hill 33.80%. plain 6.50%. (Costache et al. 2010). The largest wooded areas are in the mountains and hills, where mechanized possibilities are currently restricted. However, saplings with mechanized means are well suited to the establishment of forest protection pads which are mostly located in areas with low terrain and therefore mechanized planting is the most recommended and much more economical. Planting involves the use of saplings as forestry material and is the most commonly used forestry method in our country, in over 98% of the area forested annually in the last decades. (Ianculescu et al.. 2007).

Advantages of installing wood species through plantations are numerous:

- in some cases planting is the only possibility of artificial vegetation installation;
- seedlings ensure, in many situations, better crop success, from the first year of planting;
- crops are more resistant to adversities than those obtained by direct seedling due to the size of saplings used in planting compared to plants produced by direct seedlings;
- plantations can be made in the most varied conditions, on inclined terrain, in arid areas, on fields exposed to solar radiation, in cold and windy resorts, on fields with very abundant grass vegetation;
- seed economy is achieved compared to direct seed;
- in the first year of installation, planted seedlings are rarely exposed to deforestation compared to those obtained by direct seedlings;
- in many species, planting is easy and ensures good success;
- some species can not be installed by direct seedlings, frequently occurring in plantations (Euro-American poplar, selected willow. etc.).

Plantations also have some disadvantages:

- Saplings transplantation is a critical moment in their lives, primarily through the physiological imbalance that may arise between the water absorption capacity of the soil (the juvenile juice has a small volume of roots) and sweating, the airborne part not suffering from major transplantation (Draghia et al.. 2011).
- Planting saplings are intended for mechanization of the works of setting up crops by planting in lands with pre-prepared soil, chopped and devoid of crows, vegetal remains and weeds. Mechanized planting can be done on unprocessed land or on partially or totally processed land. In unprocessed land the saplings are planted in pits made with tractor-driven drills (fig. 1) or with specialized drilling equipment (fig. 2).

Fig. 1 - Drilling machine for drilling holes mounted on tractor[13] **Fig.2 - Drilling pits equipment** [13]

Specialized planting machines are used for planting (fig.3). Saplings are designed for the mechanization of planting works by planting in set land with pre-ground, loose and weed-free soil. A planter is generally composed of: a frame to hold the knife, the coulter, the compaction wheels, the operator's seat, and the brood-stocks.

Fig.3 - Planting machine in working [14]

The importance of the article is due to the necessity of approaching the problems related to the mechanized planting of the saplings. due to the necessity of the restoration of the forest fund and the creation of protection curtains in Romania. Increasing the degree of mechanization of forestation works leads to the reduction of labour force demand, labour productivity and the achievement of high quality indices.

For the next period an increase of the area occupied by forest vegetation is foreseen, through forestation in degraded lands unfit for agriculture and by forestation in order to achieve the National System of forest protection curtains.

MATERIAL AND METHOD

At present there are several types of seedlings that consist in principle of a planting device that is behind a tractor, where an operator destroys the saplings one by one in the planting system of the saplings, which then arrives one at a time at an equal distance between them in a sufficiently wide and deep ground opening, made by a disk-shaped wheel, followed by a broader and finally two wheels which are fixed at an angle to force the furnace to close around the brood and gather the soil around it (Fig. 1). Some equipment also has a herbicide application device. The weight of the operator helps in some variants of planting saplings to appropriate soil compaction. (Zbârnac et al.. 1986).

Saplings planting equipment is of three types as tractor attachments: carried (with three-point attachment, the machine can be raised from the ground via the hydraulic system of the tractor), semi-trailer and towed. In order to obtain a quality forestation, the following steps must be taken: preparation of the land, selection and care of planting material, planting and sowing after sowing.

Saplings planting in their composition are of various shapes: prismatic with sharp tip, prismatic with obtuse tip, flat disc with flat discs, etc., the sapping devices being of the type with adjustable blades for use with devices of the type with metal drums with wheels with tires arranged at a certain angle.

The planting apparatus can be rigid, chain-mounted, track-type or elastic discs. From the point of view planting, equipment is of the following type:

- which only open gullies in prepared ground and planting is to be done manually;
- opening gullies in prepared ground and executing planting with a manual feeding plant;
- opening gullies in prepared ground and performing planting with a semi-automatic power plant;
- opening gullies in prepared ground and performing planting with an automatic feeding plant;
- which processes the land in 0.6m strips at a depth of 0.35-0.40m. with simultaneous planting and manual feeding of the plantation. The planting apparatus speed varies depending on the field conditions, the variety and size of the seedlings, the operator's expertise and experience, reaching a figure of between 400 and 1000 seedlings per hour.

RESULTS

As planting-sowing operation is generally performed with one equipment, it is almost always necessary to make a ditch, trench, or pits followed by the planting of the juvenile itself and that the success of the planting depends to a large extent on the operation of the dwelling for the juvenile for which we will present some of the equipment that performs this operation. Equipment must be presented because many of their work parts are also found in the machinery and planting equipment component (Wangyuan et al.. 2016). For the implementation of the afforestation techniques, a wide range of machinery and equipment is required; the best known in the field of this equipment being a series of companies specialized in the field of: Finland, Austria, Germany, the Czech Republic and the United States.

In the planting equipment, sowing directly into the furrow (Figure 4), the operator puts the seedlings directly into the furrow. in Figure 5 there is presented a model of planting equipment comprising a mechanical arm that distributes the sowing into the furrow, the operator putting the seedlings on the planting arm.

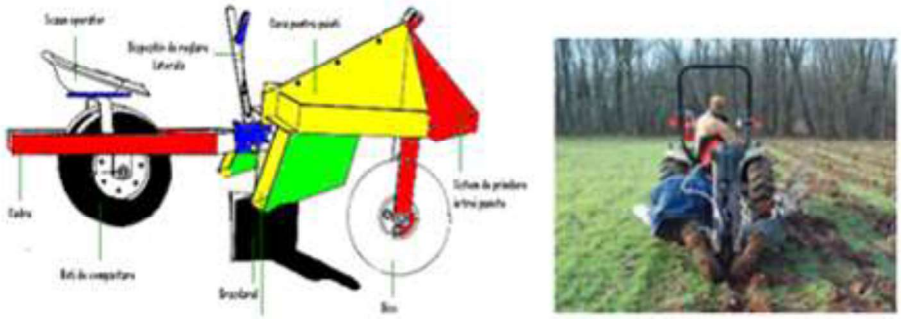

Fig. 4 - Equipment for direct planting in furrow [9]

a) draft b) view

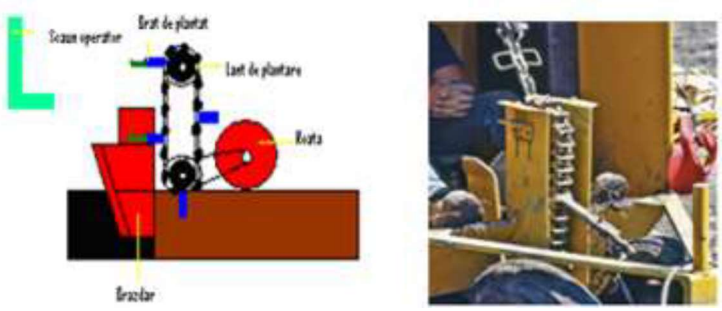

Fig. 5 - Equipment for planting with chain [9]
a) draft b) view

Figure 6 shows another constructive variant used to obtain high seed density and Table 1 presents some technological requirements.

Table 1

Technical parameter	Distance among rows [m]	Distance among plants [m]	Furrow planting		Seedlings	
			Furrow width [mm]	Depths furrow [mm]	Variant 1	Variant 2
Technical require	1.5	1	200-300	300-400	Furrow height >1m The diameter of a root yarn>2 mm	Seedlings height >0.8m The diameter of a root yarn>2 mm

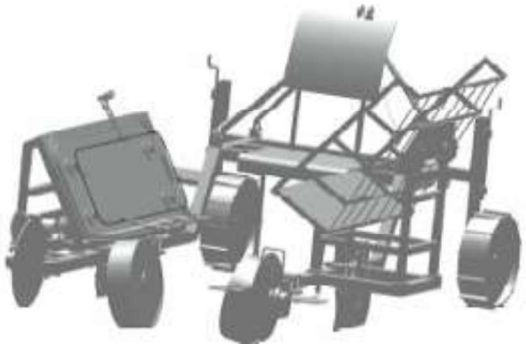

Fig 6 - Planting equipment with mechanic automatic arm [10]

The technical characteristics of this sowing plant are: length - 2017 mm. width - 1214 mm. height - 965 mm. weight - 210 kg.

Figure 7 presents a sketch of saplings planting equipment which comprises the following: 1 - frame. 2 - seat. 3 - sowing support system. 4 - coating wheels. 5 - disc. 6 - peasant. 7 - seed pots. 8 - Depth adjustment device. 9 - Transmission system. 10 - Automatic mechanical arm

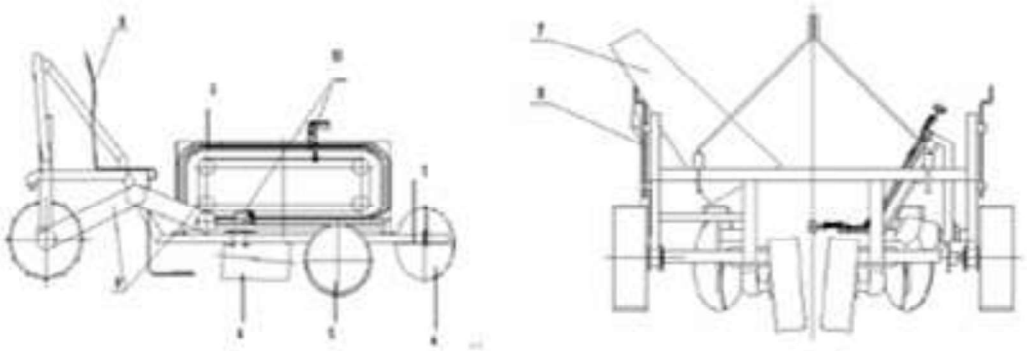

Fig. 7 - Parts of automatic planting equipment [10]
a) lateral view; b) back view

The automated mechanical arm part of the various variants of planting seedlings is designed by simulating the human hand gripping mechanism. in Figure 8 there is presented a model of such arm consisting of the following components: 1 - chain grip. 2 - upper roll . 3 - arc. 4 - connecting rod. 5 - upper truss. 6 - brood. 7 - lower truss. 8 - lower cylinder.

Fig. 8 - Automatic mechanic arm [5]
a) Mechanic automatic arm view; b) The kinematic scheme of the mechanical arm

Another constructive variant of the saplings plant (Figure 9) is the elastic disc version.

Fig. 9 - Equipment for planting saplings with elastic discs [14]

Disc harrows are made up of two elastic discs that by rotation will reach a portion of the length of their tangential circumference due to the construction variant, either by rollers or by the tilting of the trees that support and trains the discs.

The Egedal Hydromatic type machine (fig. 10) - is a machine equipped with an anchor-type coulter and inclined wheels for grounding and compaction around the planted juvenile. Compared to the models presented so far, where the operator introduces the juvenile into the gully in a position and at a random depth, with the disadvantages of the unevenness of the resulting plantation, in this model the juvenile is positioned in a planting mechanism with arms and tweezers that make the placement of the brood in the gutter. The advantage of machines of this type is that it allows achieving an increased precision for depth and planting distance between seedlings per row.

Fig.10 - Egedal Hydromatic machine type [13]

The RPK-S type machine (fig. 11) - is intended for planting small saplings on two rows, it is of the type worn on power tractors ranging from 45 ... 65CP. It has as an operating tool an anchor type coulter for opening the drain at a depth of approx. 20 cm.. Gully where the seedlings are automatically placed, then covered with soil by means of two finishers. The planting mechanism is made up of an easy-to-demolish barrel, in which the seedlings are manually placed, a chain conveyor equipped with juveniles and the transmission. During operation, each wing on the cover disc acts on the seedling drum and rotates it one step, while a chain palette takes the juice and carries it to the rig where it is released.

Fig.11 - RPK-S machine type [9]

In Romania, most forestry afforestation and forest maintenance works are executed manually, with high human labor consumption and expensive expenses. In our country, at INMA, was made the MPF1 forest seedlings plant (Fig 12a) made in a compact form, being of carried type designed for fixing in 3 points. It consists of: frame (1); transport train (2); coulter (3); planting mechanism (4). compaction wheels (5); the hydraulic installation (6); saplings (7); tractor triangle (8).

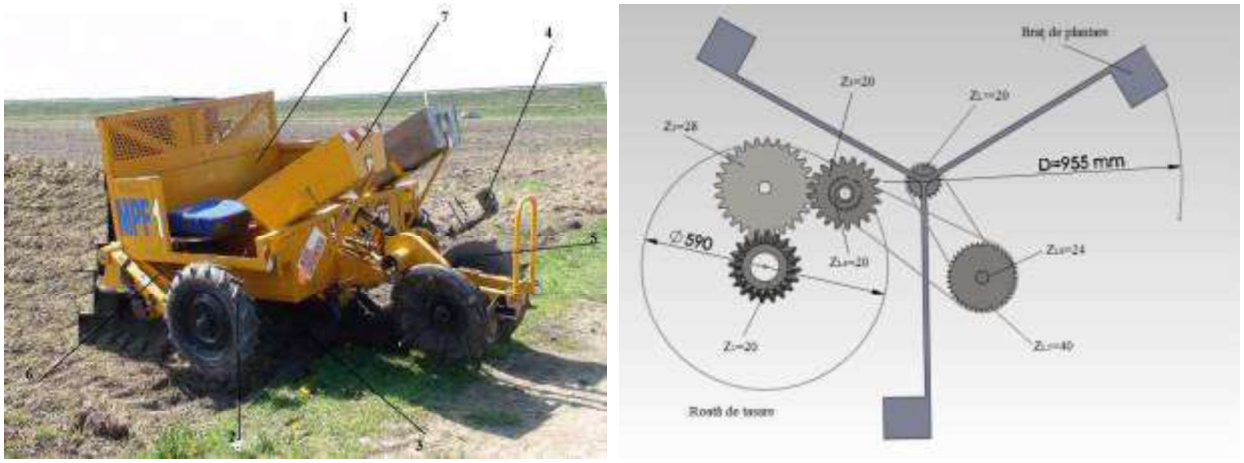

Fig. 12 - MPF1 seedlings planting machine [3.4]

a) Overall view of MPF1seedlings planting machine b) The kinematic scheme of driving the planetary arms

The planting machine MPF1 is made up of a disc on which the blades are mounted. The theoretical peripheral velocity of the planting arms is determined from the kinematic drive scheme (Figure 12b), starting from the drive wheel, transmission and finally the planting arm.

For ideal operation, the peripheral speed of the juvenile root should be equal to the feed rate of the aggregate or to the peripheral speed of the drive wheel so that when the brood is released into the soil the difference between the two speeds zero, while the drive wheel runs without skidding, thus ensuring a position as close as possible to the vertical of the planted juvenile. while respecting the planting distance between the proposed seedlings (Li et al.. 2009; Yonghua et al.. 2015. Draghia et al.. 2010). The peripheral speed of the drive wheel is calculated with relation (1), considering the wheel speed = 1

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$$V_{pa} = R \cdot \omega_a = \frac{R \cdot \pi \cdot n_a}{30} = \frac{0{,}295 \cdot 3{,}14 \cdot 1}{30} = 0{,}031 m/s \quad (1)$$

In order to observe the condition of equality between the two peripheral speeds, there is a combined gear and chain wheel transmission between the drive wheel and the planting wheel disc. (Fig. 9b), which perform a reduction ratio. Thus, the speed of the disk with arms is determined with the relation:

$$n_d = n_a \cdot i_{tr} = n_a \frac{Z_{L4}}{Z_{L5}} \cdot \frac{Z_{L6}}{Z_{L7}} = 1 \cdot \frac{20}{40} \cdot \frac{24}{20} = 0{,}6 \quad (2)$$

The peripheral speed of the disk with arms is determined as follows:

$$V_d = R\omega_d = \frac{R \cdot \pi \cdot n_d}{30} = \frac{0{,}477 \cdot 3{,}14 \cdot 0{,}6}{30} = 0{,}031 m/s \quad (3)$$

If the working speed is higher than the peripheral speed of the planter, at the level of the part that will remain in the soil, the planting distance will be higher than the one set and the juvenile will be tilted from the vertical towards the front of the equipment. If, on the contrary, the speed of the equipment is lower than the peripheral speed of the appliance, then the distance between the seedlings per row will be smaller and the juvenile will be inclined towards the back of the equipment.

The traction power For the MFF1 forest seedlings is determined by calculation based on the displacement velocity vl of the aggregate and the traction force Ftr = Rtr of the machine by means of the relationship (Draghia et al.. 2011) (4)

$$P_{tr} = \frac{F_{tr} \times v_l}{1000}, kW \quad (4)$$

where F_{tr} is measured in N and v_l în m/s.

The power required to drive the plant Pa. is the product of the moment transmitted by the wheel and its speed according to the relationship (5)

$$P_{tr} = \frac{M_t \times n_r}{1000} = \frac{(F_t + F_{aV}) \times R_r \times n_r}{1000}, kW \quad (5)$$

in which: F_{aV} – vertical component of the the forces in the pushing force springs. Rr - the driving wheel radius.

CONCLUSIONS

Romania is one of the 110 countries in the world where there are areas potentially affected by desertification as a result of frequent, long and severe droughts, mainly due to imbalances in climate characteristics but also to the severe reduction of the vegetation area forestry in lowland regions. It can be appreciated that desertification, drought and aridity have a determination in time and space, being caused mainly by climatic variations and human activity. Lack of precipitation for long periods of time causes negative effects on vegetation, soil and hydrological resources and in dry-suburban areas, manifested by:

- reducing the vegetation-covered areas, which leads to the intensification of solar radiation and implicitly to the growth of the albedo, the amplification of the effects of strong winds, micro-climatic imbalances etc .;
- the depletion of the upper horizons of soil in organic matter (humus) and nutrients by diminishing or disappearing the refreshment source (bioaccumulation);
- soil erosio,. especially by wind, on soils with sandy and even loose soils, by loss of cohesion;
- diminishing the mobilized water resources.

Protective forest crops and curtains as a means of defending climatic adversities, soil protection against erosion and landslides, protection of socio-economic objectives and communication routes have been and are in the attention of all countries with developed agriculture, where crops, soil and human settlements suffer more or less from the influences of harmful winds, droughts and surface erosion.

All these aspects lead to the necessity of carrying out the planting operation of the forest seedlings, especially by mechanized means, which imply the research of appropriate techniques in the afforestation technologies, in which the technical equipment of planting is of prime importance.

The planting operation of forest seedlings is a basic work in the restoration of the forestry fund and for the implementation of the policies formulated at the national level, it has become necessary to develop and improve some innovative technologies for mechanization of the planting of the saplings with all the implications of nature qualitative, economic, social and environmental impacts.

In conclusion, the saplings are intended for the mechanization of the planting of crops by planting in lands with pre-prepared soil, loose and free of crows, vegetal remains and weeds. Forest planters are

intended for the execution of the trench and fixation of the material to be planted in the soil in the vertical position.

Planting saplings are generally restricted to land with a maximum gradient of 20%, planting operations being often limited by soil condition (if the soil is too wet the equipment can not be used and if the land is too dry, seedlings do not survive). Mechanized planting of seedlings is much more economical and productive than manual planting, the yield of planting equipment depends on the model and type of machine used, the planting material (seed sizes) and the quality of the soil preparation.

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