EXPERIMENTAL DEVICE FOR THE RESEARCHES ON THE PRECISION OF THE TUBERS PLANTING DISTANCE WITHIN THE ROW FOR DIFFERENTS POTATO PLANTERS

S. Ilyes, S. Popescu, and E. Voicu.

Absrtact. *The paper presents the construction of an experimental device for planting potato tubers made up of two distinct sections mounted in parallel on a common frame: a section equipped with a chain and bucket distributing device and an another section equipped with disk and grappling irons distributing device. In order to carry out the comparative analysis on the precision of tubers planting distance within the row, the equipment was tested during the working process and was adjusted for different distances between tubers in row as well as for different speeds. The statistical measurements and processing enabled the analysis of the working conditions upon the planting precision of the two different planting sections.*

Keywords: *potatoes planter, tuber distributors, experimental research, in-row tuber spacing, tuber planting precision*

.

INTRODUCTION

Mechanized planting of potato tubers consists in simultaneously performing of the following three operations: open culvert with a coulter, distribution of tubers with a distribution device and cover gutters with a soil layer with thickness of 8 ... 10 cm (billons formation) by means of covering organs [3;4]. As a result, the main bodies of work which is part of a potato planting machine are: body for drain opening, distribution unit with the clamping device (if any) or control unit and completion the tubers gaps (if any) and covering bodies with soil of the potato tubers.

From the constructive and functional point of view, tuber distribution apparatus are made in several variants, the most important being the following: distribution unit of tubers with chain and spoons, with vertical disc with notches and clamping flaps of the tubers, with vertical disc with flaps and catching spurs of tubers, with vertical disc with spoons and supporting fingers of tubers, with vertical disc with clamping pins and separation device of the tubers, with flaps mounted on vertically disc and clamping pins and with drawing device [1;2:3].

MATERIAL AND METHODS

The main objectives of experimental research are: devising an experimental research method and programme such as to allow relevant testing related to the main quality indicators: planting uniformity and planting precision regarding the distance between tubers in a row and comparison of the quality indicators for the two cases of planting sections under identical soil, adjustment and working conditions and formulation of conclusions and recommendations.

For acomparative analysis of functional behavior in identical working conditions of the two types of sections of planters (with distribution apparatus described above), to determine the quality indicators of their work, was designed and built an experimental device consisting of two different sections for potato tubers planting: one section with vertical disc and flap pockets and a section of chain with spoons (mounted in a single row).

To the achievement of experimental equipment was used a section from a tuber planter towed machine equipped with planting device with disc with flaps (model SA 2-070, made of company Agrostroi Prostejov from Czech Republic), hereinafter section type *MARS* and a section of a carried tuber planting machine equiped with a planting device with chain and spoons mounted on a single row, (model: SD 55, made by the company RAMR from Germany), hereinafter section *CRAMER* type. The two sections were mounted on a common frame, the coupling to the tractor being made via the 3-point linkage of the tractor.

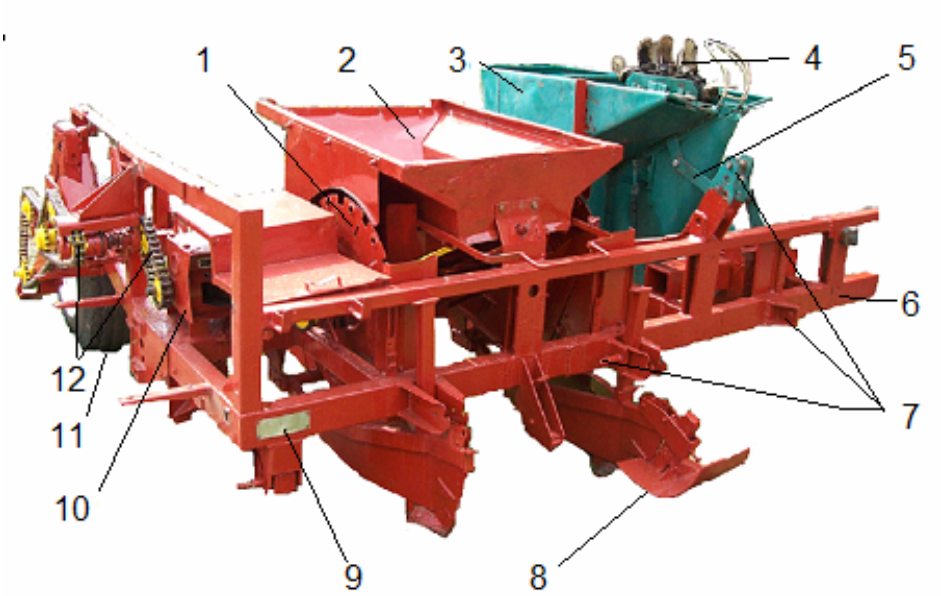

Fig. 1. *Construction of experimental equipment*

Fig. 2. *The view from the back of the tractor aggregated with the experimental equipment in operation*

From planter with vertical disc and flaps (MARS type) has been kept the ensemble of disc 1 (Fig. 3) and all kinematic elements: transmission chains 24 and 18 (see Fig. 2), Norton gearbox 10 (with 8 steps), driving wheel 11 and distribution shaft shortened 17 with bearing 16 (see Fig. 2), and the traction device was changed with the three-point suspension device 7. From the planting section with chain with spoons mounted in a single line (CRAMER type), with own driving from the driving wheels with blades 14 (see Fig. 2), was mounted on the support (the frame) 6 of the other machine by independent coupling through the mechanism parallelogram 5, maintaining the driving through the chain box 12 and the independent driving delimited by the bar 15 (see Fig. 2). In this way the two different structural-functional sections can operate simultaneously in the same conditions and independently by the driving of one relative with the other. Each of the sections kept the original driving kinematic chain with degrees of freedom previously had and with the

possibility of supply from bags for different tests and were able to make the necessary adjustments as in their original form.

The original bunker of feeding the MARS machine was modified to be able to feed only one section (of the dual) by filling with an elastic element of the other opening of the dosing chamber. From the original MARS towed machine have been removed all elements which had no longer functional role (big bunker with the supports, the coulters, the legs of transport wheel, the tow bar), in order to reduce as much as possible the weight of the experimental equipment. The distribution shaft 17 (see Fig. 2) from the two original sections was shortened and modified, by positioning of bearing housing 16 in order to match the transmission with chain 18. For safety, on the genuine frame 6 of the machine was mounted by welding a spacer 15 to maintain the distance to the station CRAMER, ensuring the unhindered driving of it from the driving wheels 14 and through the gearbox 13 (see Fig. 2).

Experimental tests were conducted on field, on a soil prepared for sowing. The field was properly prepared by carrying out the spring plowing followed by successive discing in multiple passes, the land surface has been parceled and picketed realizing four consecutive working plots with travel lengths of 50 m separated by areas of 10 m length each one for changing the speed of a moving of the machine for the next tests and with turning area at the ends. According to the preset program, the experimental tests were performed in different working conditions: with tuber of various shapes and sizes, with different planting distances on row and with different planting speeds.

Measurements were made by moving the of the experimental equipment coupled at the tractor on four consecutive plots for four different determined working speeds (1.5 km/h, 2.2 km/, 3 km/h and 3.5 km/h). At each adjusted planting distance and for each established type of planted material (tubers of certain shapes and size fractions) has carried out a series of four passes at different speeds. After the first adjusted planting distance on the row and after performing of the four successive passages, the aggregate returned at the original end of the test field, where the feed bins there were emptied, was changed the type of planting material then run again the four successive passages align the initially planted rows. These series of experiments were repeated until all prepared combinations of shape and size of tubers have been planted with the two sections. After that the necessary measurements were made, after which both sections were adjusted at another value of the planting distance. Using the new planting distance adjusted, all experiments were repeated under the same conditions described above, followed of the necessary measurements. Similarly, these experiments were repeated and for the third adjusted planting distance, followed by the appropriate measurements.

The bunkers of tubers for the two distribution devices have been fed from the bags prepared in advance, marked and grouped at end of the test field. The tubers for planting have been previously prepared by sorting according to the following fractions of sizes: 30...40 mm, 40...50 mm and 50...60 mm, respectively after the geometrical forms as follows: round, oval and long. In the tests was not used the long tubers group, from the fraction of 50 ... 60 mm, testing being performed in all with eight distinct groups of tubers. Thus, the experimental conditions used have been as follows: the shape and size of tubers assort, the size of the planting distance on row, the travel (working) speed of the equipment. For performance of the experiments and taking measurements have been considered the following issues:

- the possibility of regulating of the planting distance to be as close for the two types of the sections of planters (CRAMER/MARS). For these were chosen the following of the plantation distances: 20/21 cm, 28/27 cm, and 33/33 cm;
- achieving of a correlation of the values of planting speeds with those given in the machine manuals, choosing the following four values of speeds: 1.5 km/h, 2.2 km/h, 3 km/h and 3.5 km/h. The achievement of these values was possible by using of modern

tractors: JOHN DEERE 4755 and JOHN DEERE 4040S;

- grouping ability by different geometric shapes of tubers: round, oval and long, using characteristic varieties of these geometrical forms, such as: Chips, Ostara and, respectively, Laura;
- grouping of tubers by the following size fractions: 30...40 mm, 40...50 mm and 50...60 mm.

For each experiment combination carried out on the 50 m plots, was made the measurement of the actual planting distances between the tubers, thus resulting for each experimental case parallel values for 151...250 real planting distances. The results of measurements were included into sheets with tables previously prepared, which were subsequently entered into the computer and were processed in EXCEL to achieve the following quality indices: actual planting distance, uniformity distribution of of tubers into row, the frequency of nest failure, frequency of nest with tuber double, the average number of tubers into the nest, precision planting, the standard deviation of the planting distance, variation, the coefficient of variation of the distance between the tubers. These calculated indexes have been introduced into tables for the graphical representation.

RESULTS AND DISCUSSION

Analysis and interpretation of the acquired results have led to the construction of charts that are allowed the elaboration of some conclusions on functional comparison of the 2 types of potatoes planters: one with planting section with vertical disc and flap pockets and another with planting section of chain with spoons (mounted in a single row).

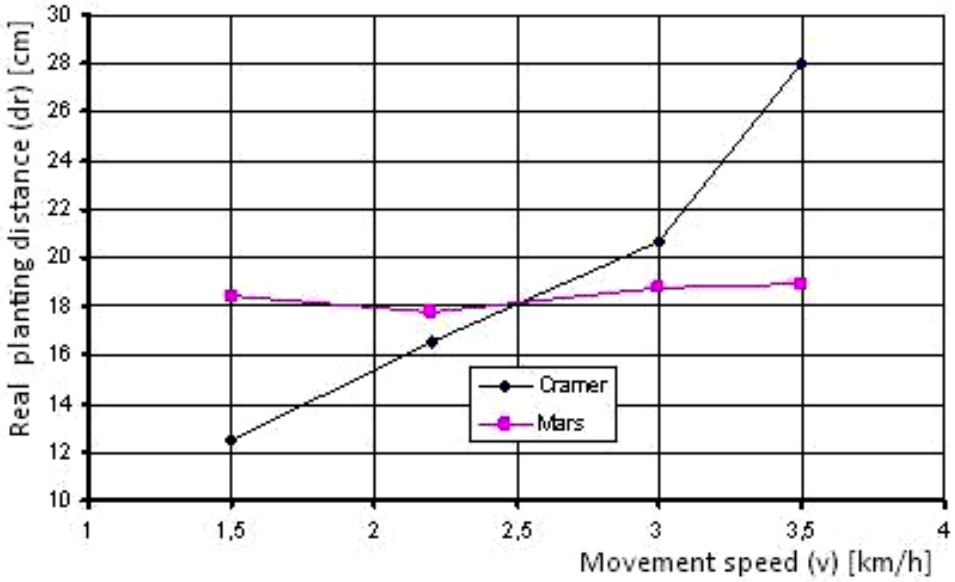

Fig. 3. Graphical representation of the real planting distance variation at the two types of sections (CRAMER and MARS) depending on the working speed, for round-shaped tuber from fraction: 30...40 mm and the planting distance set to 20 cm (CRAMER)/21 cm (MARS)

For example, for the adjustment to planting distance on row (20 cm for CRAMER and 21 cm for MARS section), at the use of tubers from 30...40 mm fraction and round sort, is observed that at the increasing of working speed from 1.5 km / h to 3.5 km / h, the value of the real distance (the average distance of the measured distances) growth faster at CRAMER section compared the MARS section (Fig.3.)..

Generally, the actual planting distance values are more stable, more uniform in case of section MARS. In case of section CRAMER at smaller speeds the actual distance values are smaller than those of the section MARS. In conclusion, at these adjustments, at increasing of work speed, the actual distance values in case of CRAMER section exceed those of the of section MARS.

At section CRAMER (with chain and spoons) for reduced planting speeds (1.5 km/h) with small tubers from 30...40 mm sort, there are more plantings in into nests as duplicates, because they are not very well removed or discarded from the spoons of chain due to the small size of the tubers, and smaller vibration of the conveyor chain. At increasing of speed over 3 km/h, for same conditions, Cramer section has no longer the planting precision as stable as MARS section because the cup type chain begin to throw the tubers outside the ascendent chute feeder and not enough tubers remain in the distribution mechanism. As a result, after the measurements performed, it is found the increasing of the real planting distance and there are more nests with missing tubers

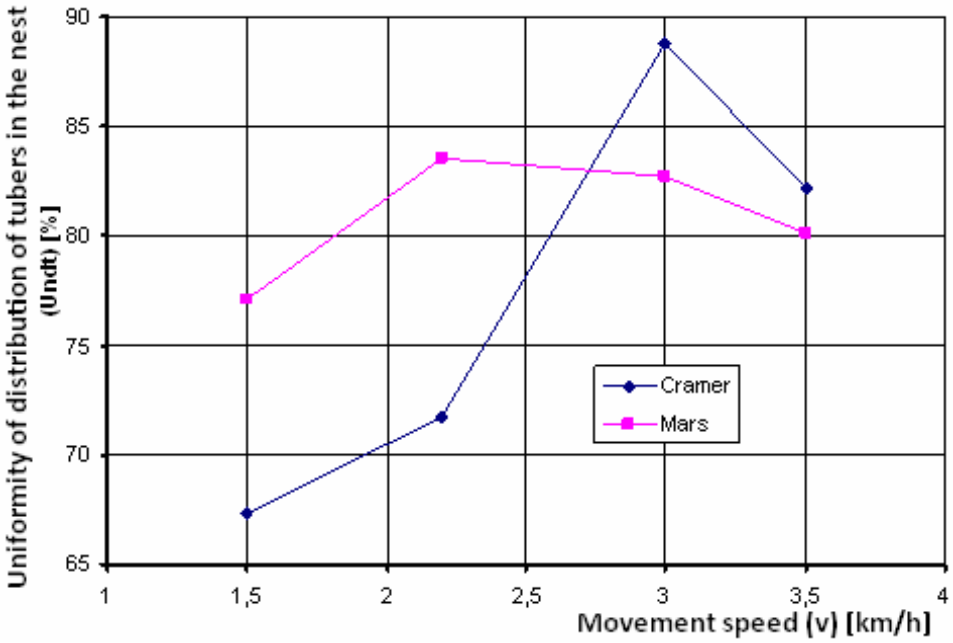

Fig. 4. Variation of uniformity of distribution of tubers into the nest at the two types of sections (CRAMER and MARS) depending on the working speed for the fraction 30...40 mm and the planting distance adjusted at 33 cm

With respect to the uniformity of distribution of tubers into the nest, from the graph presented in figure 4 is observed that at the planting distance set at 33 cm to both types of sections having as planting material round tubers from 30...40 mm fraction, the uniformity of distribution at the section MARS is higher and shows a greater stability, and to the section CRAMER the uniformity has lower values and is of a lower stability.

CONCLUSIONS AND FUTURE WORK

- A simple, quick and objective method for comparing technical, technological and working performance of various types of tuber planting equipment (sections) developed by various manufacturers of potato planting machines consists in developing experimental equipment on the frame of which the sections subjected to comparative testing are mounted;
- Comparing the qualitative work indicators determined for the operation of the two types of planting sections under identical soil, adjustment and motion conditions

allows the formulating of conclusions and recommendations useful for both manufacturers and users of potato planting machines;

- For small plating distances in a row (20…21 cm) and round tubers of 30…40 mm it could be noticed that by increasing working speed from 1.5 km/h to 3.5 km/h the average value of the planting distance increases more in section CRAMER than MARS;
- For a greater planting distance (30 cm) and the same form and dimensions of tubers, it could be noticed that the functioning of the MARS type section remains approximately stable, while in the CRAMER type section a small increase of the real planting distance can be noticed (compared to that corresponding to the 20…21 cm adjustment);
- For planting distances adjusted to 33 cm and small round tubers (30…40 mm), while the uniformity of tuber distribution in nests has a greater functional stability in both types of planting sections, the distribution uniformity in the MARS section has greater values than that in the CRAMER section.

REFERENCES

[1]. Ilyes, S., Popescu, S. Present achievements concerning the working parts of the potato planting machines. In: Scientific Papers, INMATEH IV, 2007, Bucharest/Romania, pag. 59-67

[2.] Peters, R. Sowing and Plantig. Yearbook Agricultural Engineeing, Landvirtschaftsverlag, Münster: nr.16, 2004, p. 89-92, and nr.10, 2006, p. 103-106,

[3]. Soucek, R., Maschinen und Gerate fur Bodenbearbeitung, Dungung und Aussaat, Verlag Technik GmbH Berlin, 1990;

[4]. Stout, B. A., CIGR Handbook of Agricultural Engineering, vol. III, Editura CIGR – ASAE, 1999;

ABOUT THE AUTHORS

Szylard Ilyes, S, Ph D Student, Transilvania University of Brasov, B-dul Eroilor 29, 500036 Brasov, Romania. E-mail: ilyes_szilard@yahoo.de

Simion Popescu, Professor, Ph D, Transilvania University of Brasov, B-dul Eroilor 29, 500036 Brasov, Romania, E-mail: simipop38@yahoo.com

Emil Voicu, PhD, National Institute for Agricultural Machinery (INMA) Bucharest, Romania E-mail: milivoicu@yahoo.com