

A COMPARATIVE STUDY OF THE TECHNICAL PERFORMANCES OF PRECISION SOWING MACHINES USED IN THE CULTIVATION OF MAIZE

STUDIUL COMPARATIV ASUPRA PERFORMANTELOR TEHNICE ALE UNOR MAȘINI DE SEMĂNAT DE PRECIZIE UTILIZATE LA CULTURA PORUMBULUI

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Abstract: *In this paper we present the technical performances of the precision sowing machines MONOSEM NG and MONOSEM NG PLUS that were tested on the stand and in working conditions. The machines were tried at different working speeds and we monitored in particular the seed distribution evenness reached by distribution devices. We could see that, though mechanic-pneumatic distribution apparatuses have a more complicated structure, they operate well and achieve a sowing precision corresponding to the crop requirements. Data showed that sowing speed should be limited to 8 km/h and that higher speeds leads to a decrease of seed distribution evenness below admitted limits.*

Rezumat: *Lucrarea prezintă performanțele tehnice ale mașinilor de semănat de precizie MONOSEM NG și MONOSEM NG PLUS, care au fost testate pe stand și în condiții de lucru. Mașinile au fost încercate la diferite viteze de lucru și s-au urmărit în special uniformitatea de distribuție a semințelor realizată de aparatele de distribuție. S-a constatat că deși aparatele de distribuție mecano-pneumatice au o construcție mai complicată funcționează foarte bine și realizează o precizie de semănat corespunzătoare cu cerințele culturii. În urma datelor obținute s-a constatat că viteza de semănat trebuie limitată la o valoare de 8 km/h iar depășirea acestei limite de viteză duce la scăderea uniformității de distribuție a semințelor sub limitele admise.*

Key words: *precision sowing machine, mechanic-pneumatic distribution machine, individual and centralised operating, technical performance.*

Cuvinte cheie: *semănătoare de precizie, aparat de distribuție mecano-pneumatic, acționare individuală și acționare centralizată, performanțe tehnice.*

INTRODUCTION

Precision sowing machines are meant to distribute the grains one by one and to incorporate them in the soils at precise depths, according to the crop.

At present, there are worldwide three groups of plants that need precision sowing, i.e.:

- field crops: maize, sunflower, soy, sugar beet, sorghum, pea, bean, lentil, ricin, cotton, chickpea, seed hemp etc.;
- vegetables: watermelon, cucumber, carrot, onion, mustard, small bean, okra, lettuce, cabbage, tomato, green pepper etc.;
- medicinal plants: coriander, crocus, chicory, anise, sesame etc.

All these plants, due to their rich content in nutrients and to the possibility of valorising wastes resulted from harvesting and processing are of great importance for agriculture.

The most important sub-aggregate of a sowing machine with a decisive role in reaching and maintaining good precision in sowing is the distribution device.

There are worldwide several types of distribution devices characterised by the fact that

their active elements distribute individual seeds. Depending on the way the active elements does this, distribution devices can have mechanical or mechanic-pneumatic distribution.

Mechanic distribution devices can have hole discs, alveoli discs, alveoli plate, finger plate, and hole strips.

Mechanic-pneumatic devices can have hole discs or hole plates.

MATERIAL AND METHOD

Experiments were carried out on the field of the Didactic Station of the BUASVM in Timisoara in 2008.

We studied the precision sowing machines MONOSEM NG, with a centralised operating distribution device, and MONOSEM NG PLUS with individual operating distribution device.

The trials were done on the stand and in the field, in maize.

The main parameter we monitored was the efficacy of the seed distribution achieved by the two types of sowing machines.

The sowing machine MONOSEM-NG

This type of sowing machine is equipped with centralised operating mechanic-pneumatic distribution device.

It can be used in the sowing of maize, sugar beet, sunflower, rape, soy, bean or any other crop having similar seed shape and size.

Working sections are mounted on the frame through a deformable parallelogramme (figure 1) and are operated from a gear box with 18 steps.

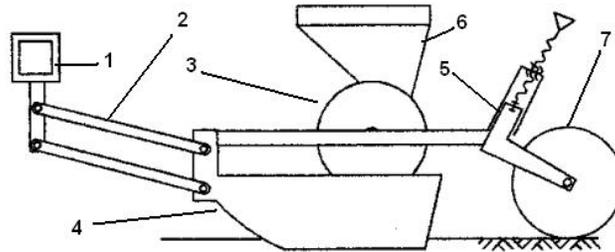


Figure 1. Diagramme of the Monosem – NG sowing machine
1-frame of the sowing machine; 2-deformable parallelograms; 3-seed distribution device; 4-coulter, 5-setting wheel regulation system; 6-seedbox; 7-operating setting wheel

The coulter is of the skate type, row distance is adjustable between 30 and 90 cm, and seed distance is adjustable in 18 steps between 3 and 26.5 cm.

The diagram of the device is presented in figure 2.

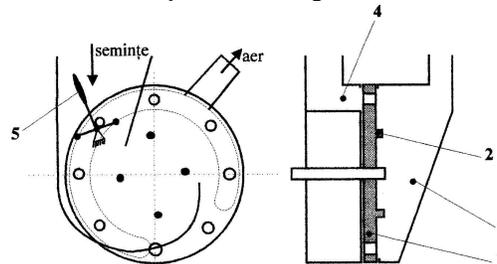


Figure 2. Seed distribution device of the MONOSEM NG sowing machine
1-hole disc; 2- stirrers; 3-seedbox; 4-vacuum room; 5-scraper

Hole disc diameter $d = 245$ mm, seed fall height $h = 165$ mm, vacuum value $p = 53$ mbar.

The sowing machine MONOSEM NG PLUS

This type of sowing machine is equipped with individual mechanic-pneumatic seed distribution devices.

It can be used in maize or in any other crop whose seeds shape and size are similar to those of the maize.

Working sections are operated from a gear box with 18 steps and are mounted through a deformable parallelogram (figure 3).

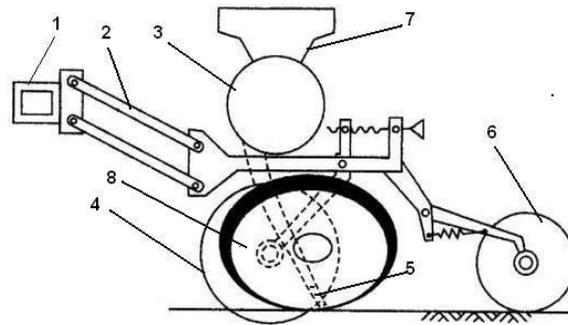


Figure 3. Section of the MONOSEM NG Plus sowing machine
1-frame; 2-deformable parallelogram; 3-seed distribution device; 4-operating wheel; 5-seed guiding tube; 6-setting wheel; 7-seedbox; 8-vacuum regulating cap

Row distance is adjustable between 35 and 90 cm. Seed distance per row is adjustable in 18 steps between 3 and 21.5 cm. Diagram of the distribution device is shown in Figure 4.

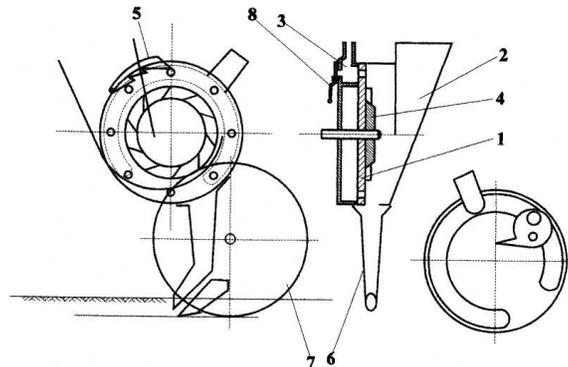


Figure 4. Seed distribution device of the MONOSEM NG Plus sowing machine
1-hole disc; 2-seedbox; 3-vacuum room; 4-stirrer; 5-scraper; 6-seed guidance tube; 7-coulter; 8-vacuum regulation cap

Hole disc diameter $d = 245$ mm, seed fall height through the tube 450 mm, seed free fall 50 mm down to the bottom.

Value of the vacuum $\Delta_p = 55$ or 53 mbar.

RESULTS AND DISCUSSION

Performances of the sowing machine MONOSEM NG on the stand, equipped with a 30-hole disc whose diameter is $\Phi = 5\text{mm}$ in maize are shown in Table 1.

Performances of the sowing machine MONOSEM NG in the field, equipped with a 30-hole disc whose diameter is $\Phi = 5\text{mm}$ in maize are shown in Table 2.

Table 1

Performances of the sowing machine MONOSEM NG on the stand

Sowing speed [km/h]	4.0	5.2	6.0	7.0	4.1	5.2	5.9
Seed distance [cm]	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Frequency [holes/s]	7.4	9.6	11.1	13.0	9.4	11.9	13.5
Disc peripheral speed [m/s]	0.17	0.22	0.25	0.29	0.21	0.27	0.30
Average abatement [mm]	8.1	11.3	13.5	16.0	9.1	12.3	13.4
Nr. of distances between 0,5d and 1,5d (normal) [%]	99.8	99.5	98.8	99.2	99.5	98.9	98.7
Nr. of distances between 0 and 0,5d (double) [%]	0.1	0.4	0.6	0.3	0.2	0.3	0.5
Nr. of distances between 1.5d and 2.5d (gaps) [%]	0.1	0.1	0.6	0.5	0.3	0.9	0.8
Nr. of distances between 2.5d and 3.5d [%]	0	0	0	0	0	0	0
Nr. of distances above 3.5d [%]	0	0	0	0	0	0	0

Table 2

Performances of the sowing machine MONOSEM NG in the field

Sowing speed [km/h]	4.5	5.3	6.5	5.0	6.0	7.0
Seed distance [cm]	14	13.9	14.1	14.2	14.2	14.2
Frequency [holes/s]	8.9	10.6	12.8	9.8	11.7	13.7
Disc peripheral speed [m/s]	0.2	0.24	0.29	0.22	0.26	0.31
Average abatement [mm]	27.8	29	31.6	28.4	28.7	28.7
Nr. of distances between 0,5d and 1,5d (normal) [%]	87.5	90.5	84.9	79.8	80.9	80.9
Nr. of distances between 0 and 0,5d (double) [%]	3.3	1.5	3.2	1.2	1.8	1.6
Nr. of distances between 1.5d and 2.5d (gaps) [%]	8.1	7.5	11.0	16.6	13.6	14.5
Nr. of distances between 2.5d and 3.5d [%]	1	0.3	0.8	1.9	3	2.3
Nr. of distances above 3.5d [%]	0.1	0.2	0.1	0.5	0.7	0.7

Performances of the sowing machine MONOSEM NG PLUS on the stand, equipped with a 30-hole disc whose diameter is $\Phi = 5\text{mm}$ in maize are shown in Table 3.

Performances of the sowing machine MONOSEM NG PLUS in the field, equipped with a 30-hole disc whose diameter is $\Phi = 5\text{mm}$ in maize are shown in Table 4.

Table 3

Performances of the sowing machine MONOSEM NG PLUS on the stand

Sowing speed [km/h]	4.1	5.1	6.0	7.0	4.1	5.1	6.1
Seed distance [cm]	15.0	15.0	15.0	15.0	12.1	12.1	12.1
Frequency [holes/s]	7.6	9.4	11.1	13.0	9.4	11.7	14
Disc peripheral speed [m/s]	0.17	0.21	0.25	0.29	0.21	0.26	0.32
Average abatement [mm]	10.6	13.3	14.6	18.0	11.3	13.6	15.4
Nr. of distances between 0,5d and 1,5d (normal) [%]	99.3	99.3	99.2	98.3	99.5	98.6	98.9
Nr. of distances between 0 and 0,5d (double) [%]	0.4	0.1	0.2	0.5	0.2	0.4	0.6
Nr. of distances between 1.5d and 2.5d (gaps) [%]	0.3	0.6	0.6	1.2	0.3	0.8	0.5
Nr. of distances between 2.5d and 3.5d [%]	0	0	0	0	0	0.1	0
Nr. of distances above 3.5d [%]	0	0	0	0	0	0.1	0

Table 4

Performances of the sowing machine MONOSEM NG PLUS in the field

Sowing speed [km/h]	4.4	5.4	6.7	4.2	5.0	6.0	6.3
Seed distance [cm]	14.3	14.3	14.3	12.1	12.3	12.3	12.4
Frequency [holes/s]	8	10.5	13	9.6	11.3	13.6	14.1
Disc peripheral speed [m/s]	0.18	0.24	0.29	0.22	0.25	0.30	0.32
Average abatement [mm]	26.4	27.8	30.1	25.2	26.9	26.7	29.1
Nr. of distances between 0,5d and 1,5d (normal) [%]	91	90.1	88.1	89.6	90.3	88.0	87.6
Nr. of distances between 0 and 0.5d (double) [%]	1.4	2	1.5	1.5	1.5	2.3	3.5
Nr. of distances between 1.5d and 2.5d (gaps) [%]	7.3	7.4	9.9	8.2	7.9	8.4	8.3
Nr. of distances between 2.5d and 3.5d [%]	0.2	0.5	0.4	0.5	0.2	0.7	0.4
Nr. of distances above 3.5d [%]	0.1	0	0.1	0.2	0.1	0.5	0.2

CONCLUSIONS

Sowing machine productivity is directly proportional to the working speed and width. Data presented show a limitation of the sowing speed at 8 km/h, speeds above this one leading to a decrease of seed distribution evenness below admitted limits.

1. Data presented also show a difference between the performances of sowing machines equipped with the same seed distribution device; choosing another type of distribution device is not enough, since there are differences between the quality of the works done with sowing machines equipped with the same type of distribution device.

2. Besides reaching and maintaining even seed distribution, sowing machines also need to meet the following conditions:

- drop the seeds at adjusted depth;
- lack aggressiveness in seed distribution;
- be adjustable from the point of view of seed distance;
- be simply built;
- be easily serviceable and adjustable;
- have high productivity.

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