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**IMPROVING THE FERTILIZING TECHNOLOGY BY A MACHINE WITH  
SPREADING DEVICE EQUIPPED WITH TWO DISCS, FOR SPREADING  
LOW RATES OF CHEMICAL FERTILIZERS**

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**Abstract:** *This paper contains the results regarding the researches concerning the manufacturer of a machine for spreading in field crops chemical fertilizers and chalking, MA 3.6. The machine MA 3.6 contributes to diversifying the range of machines designed for chemical fertilizing and soil quality improvement and spreading low quantities of mineral fertilizers, according to the present orientations regarding the environmental protection.*

**Keywords:** *chemical fertilizer process*

## 1. INTRODUCTION

Applying innovative agricultural practices, based on the most recent scientific knowledge in technologies field, referring to controlled chemical fertilizing technologies is an important requirement of sustainable agriculture promoting. Therefore, designing and implementing performant technical equipment, able to spread minimum rates per surface unit, without fertilizer losses on overdoses has become a real necessity along with making this equipment available for Romanian agricultural manufactures and farmers; the result is concretized in obtaining high quality and profitable productions and especially in preserving the environment and limiting the ecological damages at national, regional and local level, on short or longer term.

## 2. TECHNICAL REQUIREMENTS AND METHODS. EXPERIMENTAL RESEARCHES

Chemical fertilizers must fulfil certain agro technical requirements such us:

- to spread granulates, crystal or powder fertilizers, granulates organic-mineral fertilizers grain under 7 mm and chalking, their humidity being under the standard values;
- to provide the uniformity of chemical fertilizers and amendments spreading, both on length and width of the spreading area, the maximum deviation from the medium value must be under 15%;
- to spread quantities according to the standards, with  $\pm 3 \dots 5$  % deviation;
- during the technological process, the spreaders mustn't break the granulates fertilizers.

According to these requirements, has been designed a machine, MA 3.6 (fig.1 a, b), which can spread low rates of fertilizers.



**Figure 1:** The machine of applying chemical solid fertilizers, MA 3.6  
 a) front perspective view    b) rear perspective view

**Main technical characteristics of the Machine MA 3.6 are:**

- Type of machine ..... semi mounted
- Tractor, CP ..... min.45
- Loading mass, t ..... 3,6
- Spreading device ..... centrifugal, with 2 discs
- Spreading device driving ..... from tractor's PTO
- Spreading width, m ..... 6...24
- Spreading rate, kg/ha
  - chemical fertilizers ..... 50...1000
  - chalking ..... 800...10000
- Conveyor ..... with special link chain
- Conveyor driving ..... by the friction wheel,  
from the left transport wheel
- Wheel train ..... single axle
- Service brake ..... inertial mechanic,  
with drum and internal shoes
- Parking brake ..... mechanical, by cables
- Maximum displacement speed, km/h
  - in transport ..... 15
  - in operation ..... 8

The tests in operating conditions have included the determination of qualitative indices of the field testing:

- *Uniformity of the transversal distribution;*
- *Uniformity of the longitudinal distribution;*
- *Spreading width;*
- *Spreading fertilizers rate.*

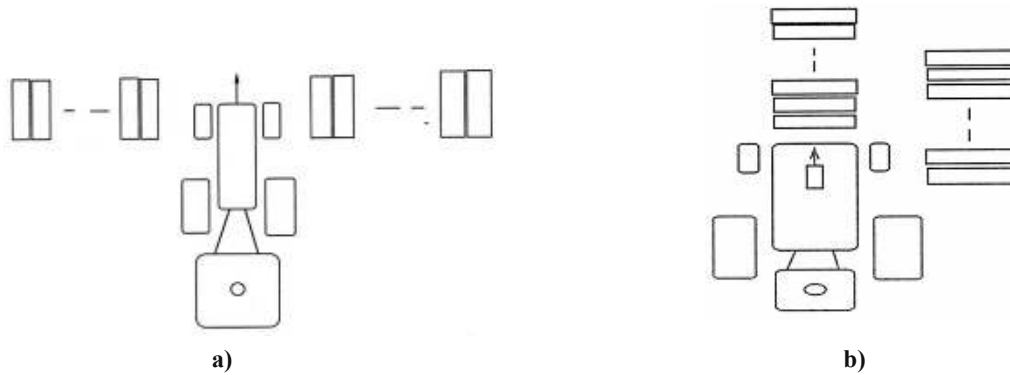
The determination of transversal distribution was accomplished in compliance with SR ISO 5690-1:1995 "Equipment for distribution of fertilizers. Test method. Part.1. Fertilizer spreading surface devices, section 5.1. (fig.2, a).

The determination of longitudinal distribution was accomplished in compliance with SR ISO 5690-1:1995 "Equipment for distribution of fertilizers. Test method. Part.1. Fertilizer spreading surface devices, section 5.2 (fig.2, b).

The collection of the fertilizers was made in trays: 250x1000 mm.

There were made experimental researches with two devices equipped by discs with diameter Ø260 respectively Ø 400, the distance between the discs  $d = 410$  mm.

After the fertilizers were collected from the numbered trays in plastic bags, the fertilizers were weighed and than it was calculated the uniformity of distribution.



**Figure.2:** Disposal scheme of the collection boxes.  
 a) Transversal spreading                      b) Longitudinal spreading

### 3. RESULTS AND DISCUSSIONS

#### 3.1. Transversal distribution

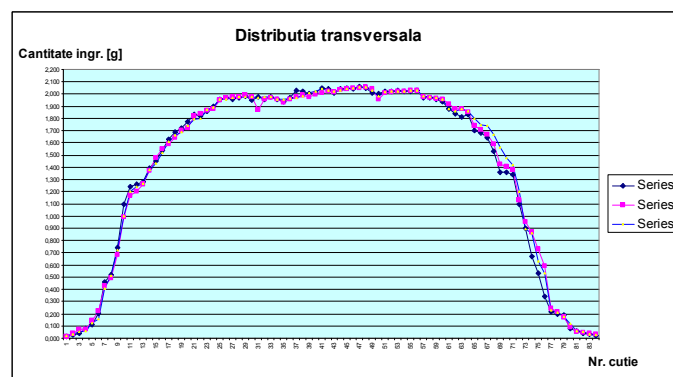
After weighing the quantities of chemical fertilizer collected in trays in the case of 3 repetitions were computed indices characterizing the quality of the spreading work. The results are shown in Table 1.

**Table 1:** Indices that characterizes the spreading work in case of transversal distribution

| Fertilizer type;<br>Spreading device type  | Degree of the uniformity of the<br>transversal distribution - $G_{ud}$ [%] |       |       |         | Stability of the flow<br>$C_d$ [%] |       |       |         |
|--|--|-------|-------|---------|------------------------------------|-------|-------|---------|
|  | R 1  | R 2   | R 3   | Average | R 1                                | R 2   | R 3   | Average |
| Complex Fertilizers<br>NPK 16.16.16;<br>Discs Ø400; d=410;<br>Palettes arranged radially | 82,79  | 84,32 | 87,15 | 84,73   | 88,72                              | 86,50 | 89,91 | 88,38   |
| Complex Fertilizers<br>NPK 16.16.16;<br>Discs Ø260; d=410;<br>Palettes arranged radially | 78,34  | 76,54 | 79,31 | 78,06   | 84,12                              | 85,57 | 87,3  | 85,66   |

d – distance between discs; R 1- 1<sup>st</sup> repetition; R 2 – 2<sup>nd</sup> repetition; R 3 – 3<sup>rd</sup> repetition

Results on **transversal distribution**, for spreading process with a device equipped with discs 400 mm diameter, average quantities, are according to the graph shown in figure 3.



**Figure 3.** Transversal distribution graph. Discs Ø 400

#### 3.2. Longitudinal distribution

The spreading process in case of the device with discs Ø260 diameter, concerning the uniformity wasn't good, registering superior behavior distribution with a spreading device equipped with discs Ø 400 mm diameter, placed at the same distance  $d = 410$  mm (Table 2).

**Table 2:** Indices that characterize the spreading work in case of longitudinal distribution

| Fertilizer type;<br>Spreading device type  | Degree of the uniformity of the longitudinal distribution - $G_{ud}$ [%] |       |       |              | Stability of the flow $C_d$ [%] |       |       |              |
|--|--|-------|-------|--------------|---------------------------------|-------|-------|--------------|
|  | R 1  | R 2   | R 3   | Average      | R 1                             | R 2   | R 3   | Average      |
| Complex Fertilizers<br>NPK 16.16.16;<br>Discs Ø400; d=410;<br>Palettes arranged radially | 87,44  | 88,09 | 88,70 | <b>88,08</b> | 89,72                           | 87,50 | 90,91 | <b>89,38</b> |
| Complex Fertilizers<br>NPK 16.16.16;<br>Discs Ø260; d=410;<br>Palettes arranged radially | 81,77  | 77,15 | 74,10 | <b>77,67</b> | 83,12                           | 84,57 | 86,3  | <b>84,66</b> |

d – distance between discs; R 1- 1<sup>st</sup> repetition; R 2 – 2<sup>nd</sup> repetition; R 3 – 3<sup>rd</sup> repetition

Results obtained by weighing the amount of fertilizer collected in trays, which have spread by two devices, with discs 260 mm diameter, respectively with discs 400 mm diameter, in case of three repetitions, are according to the charts presented in figure 4.

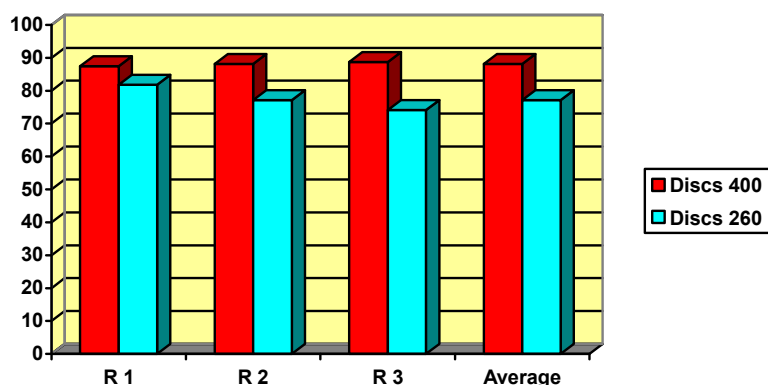


Figure.4: Uniformity degree of the longitudinal distribution -  $G_{ud}$  [%]

### 3.3. Width distribution

The spreading width was determined taking into account the transversal distribution uniformity, resulting a spreading width of about 16...17 m. In order to obtain the same amount of fertilizer per unit area, at the next transition of the aggregate in the spreading process, there will be necessary a 3 m overlap.

### 3.4. Rate of fertilizer spread

The results recorded for the minimum opening damper plate's position, at 1<sup>st</sup> division, the average position at 3<sup>rd</sup> division and the maximum position, the 6<sup>th</sup> division, are shown in Table 3.

Table 3. Rate of fertilizers distributed per hectare

| Rate of fertilizers per hectare [kg/ha] | Discs Ø260; Palettes arranged radially |       |       |       |       |       |
|---|--|-------|-------|-------|-------|-------|
|   | Damper plate's position                |       |       |       |       |       |
|   | Div.1                                  | Div.2 | Div.3 | Div.4 | Div.5 | Div.6 |
| Complex fertilizer NPK 16.16.16         | 76                                     | 150   | 225   | 300   | 375   | 450   |
|   | Discs Ø400; Palettes arranged radially |       |       |       |       |       |
|   | 60                                     | 125   | 185   | 245   | 305   | 370   |

## 4. CONCLUSIONS

The tests performed with the machine for applying solid chemical fertilizers and chalking, MA 3.6, have concluded that we can obtain a high qualitative value and appropriate work to agro-technical requirements; these indexes are characterized by a uniformity degree of longitudinal and, respectively crossing distribution  $G_{nd} > 75\%$  and a flow rate constant  $C_d > 85\%$ , in accordance with agro technical requirements, the effective spreading with being of approx. 16 m and a low rate of fertilizers, approx. 50...60 kg/ha.

However, the uniformity of longitudinal and transversal distribution and the distribution's stability are better when the machine MA 3.6 is equipped with a spreading device with discs of Ø400 diameter, compared with that equipped with discs of Ø260 diameter.

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