

## EXPERIMENTAL RESEARCH OF INFLUENCE OF MF 9108 VE PLANTER SETTINGS ON SUNFLOWER YIELD

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**Abstract.** The research is devoted to the influence of the row unit pressure force, planting depth, singulation and planting speed on sunflower germination and yield. Planting depth is crucial for technological operations of planting sunflower seeds. The research of planting sunflower seeds at a depth of 3.8 cm, 5 cm and 7.6 cm was performed using the MF 9108VE planter. Pressure force on the planter row unit is also important at planting operation. Insufficient pressure force leads to loss of the planting depth, planting of seeds in soil with low humidity and loss of the yield. Planting with excessive pressure force on the row unit leads to compaction of the root zone for plants and as a consequence the crop loss. The research of the pressure force on the row unit has been done with help of the Delta Force system from the Precision Planting company. The system has been adjusted to the pressing mode 200 kg, 20 kg, automatic mode (the contact force of the row unit depth wheels with soil at level 50 kg). Doubles and skips also have influence on sunflower yield. Therefore, the research of singulation is extremely important. If we have the doubles, we will have competition between plants, stress for them and a significant reduction of the yield. If we have skips, we will have the planting rate reduction, reducing of sunflower heads quantity in the row, and yields decreasing. The research of sunflower planting has been done with singulation 79.22% and the control plot with a singulation 96.05%. The research of how the planting speed 8 and 12 km·h<sup>-1</sup> influences on quality of planting and sunflower yield has been done. Based on the research results of the MF 9108VE planter with Delta Force system, the following operating modes can be recommended: plating depth – 5 cm, planting speed – 12 km·h<sup>-1</sup>, Delta Force in automatic mode with depth wheel force to the soil 50 kg, singulation at the level 96%. Such settings of the planter allow to raise the yield up to 0.4 t·ha<sup>-1</sup>.

**Keywords:** pressure force, planting depth, planting speed, singulation, Delta Force, sunflower yield.

### Introduction

Sunflower can be produced in a relatively wide range of environments compared to other oilseed crops. Globally it is grown in more than 80 countries with the greatest acreage in Russia, Ukraine, Argentina, Turkey and Romania. Sunflower seeds are grown primarily for oil and for the confectionary market [1]. The United States Department of Agriculture (USDA) estimates that the world sunflower production 2021/2022 will be 57.31 million metric tons [2].

Sunflower, like other crops, requires proper seedbed conditions for optimum plant establishment. Seedbed preparation, soil tilling, planting date, planting depth, row width, seed distribution and plant population should be nearly correct as conditions permit. If an improper plant stand exists, this likely will cause production challenges throughout the growing season [3].

Planting is a very important technological operation [4]. The mistakes during this operation cannot be corrected, and the impact on yields is enormous. If you want to have a good result, you will need right adjust of the planter. Thousands of seeds are planted per hectare. It is not realistic to correct the errors on hundreds and thousands of hectares if we have incorrect set of the planting depth, row unit pressure force or low singulation.

The planting depth is crucial for technological operations of planting sunflower seeds. Planting at small depths leads to incredible crop losses, because the soil moisture is not enough. Planting at big depths leads to loss of germination energy and, as a result, loss of yield [5; 6].

The pressure force on the planter row unit is also important at planting operation. Insufficient pressure force leads to loss of the planting depth, planting of seeds in soil with low humidity and loss of the yield. Planting with excessive pressure force on the row unit leads to compaction of the root zone for plants and as a consequence the crop loss [7].

Doubles and skips also have influence on the sunflower yield. Therefore, the research of singulation is extremely important. If we have the doubles, we will have competition between plants, stress for them and a significant reduction of the yield. If we have skips, we will have the planting rate reduction, reducing of sunflower heads quantity in the row, and yields decreasing.

## Materials and methods

We used the MF 9108VE planter [8] with with Delta Force system [9] (Precision Planting company) from AGCO corporation for research of the row unit pressure force influence, planting depth, singulation and planting speed on sunflower germination and yield.

The researches were made in the field of AgriLab LTD in Kyiv region, Ukraine country on April 29th, 2020. The primary tillage was made at 40 cm depth. The field was applied by technical Urea ( $\text{CH}_4\text{N}_2\text{O}$ ) at the rate of  $150 \text{ kg} \cdot \text{ha}^{-1}$ , before planting cultivation.



Fig. 1. Planting with help of MF 9108VE planter with tractor MF 7722

Nine research options were conducted, according to the task.

Table 1

### Variants of plots at the research

No.	Name of plot
1	Pressure force on the planter row unit – 200 kg
2	Pressure force on the planter row unit – auto DF mode
3	Pressure force on the planter row unit – 20 kg
4	Planting depth – 3.8 cm (1.5 inch)
5	Planting depth – 5.0 cm (2.0 inch)
6	Planting depth – 7.6 cm (3.0 inch)
7	Poor singulation with speed $8 \text{ km} \cdot \text{h}^{-1}$
8	Good singulation with speed $8 \text{ km} \cdot \text{h}^{-1}$
9	Speed of planting $12 \text{ km} \cdot \text{h}^{-1}$

Plots 1-3 are responsible for the pressure force on the planter row unit, 4-6 are responsible for the planting depth, 7-10 for singulation and planting speed.

The planting research of the pressure force on the row unit has been made with help of the Delta Force system. Delta Force is an automated row by row downforce control system that measures and adjusts downforce every time there is variability in your field, so your crops will thrive for optimal yields. The system has been adjusted to the pressing mode 200 kg, 20 kg, automatic mode [10] (the contact force of the row unit depth wheels with soil at level 50 kg). The singulation was 96%, planting depth – 5 cm, planting speed –  $8 \text{ km} \cdot \text{h}^{-1}$  at this plot.

The research of planting sunflower seeds at a depth of 3.8 cm, 5 cm and 7.6 cm was performed with pressure force on the planter row unit in auto DF mode. The singulation in that case was 96%, planting speed –  $8 \text{ km} \cdot \text{h}^{-1}$ .

The research of sunflower planting has been made with singulation 79.22% and the control plot with singulation 96.05%. The special disks of the vSet2 metering unit were made to achieve 79.22% singulation. These disks have 2 addition holes for doubles, 2 holes are blocked for skips. The Delta Force system in this plot has been worked at automatic mode (the contact force of the row unit depth wheels with soil at level 50 kg), planting depth – 5 cm, planting speed –  $8 \text{ km} \cdot \text{h}^{-1}$ .

The influence of the planting speed 8 and 12 km·h<sup>-1</sup> on sunflower yield has been investigated with using a conventional seed tube in the row unit. The Delta Force system in this plot has been worked at automatic mode (the contact force of the row unit depth wheels with soil at level 50 kg) and the planting depth – 5 cm.

Harvesting was done with help of the MF 7370 Beta combine, after the planting campaign, application of protection and nutrition. Each plot was collected separately, chewed on scales and several samples were taken to determine the moisture content of the grain.



Fig. 2. Harvesting with help of MF 7370 Beta combine

After determining the humidity, the yield was converted to a standard humidity of 8%.

## Results and discussion

All experimental data have been processed with help of Microsoft Excel program [11; 12]. The research results are shown in Table 2.

Table 2

### Research results

Plots	Seed weight from the plot, kg	Humidity in the tank, %	Humidity according to standard, %	Yield, t·ha <sup>-1</sup>
Speed of planting 12 km·h <sup>-1</sup>	210	7.6	8	2.7
Good singulation with speed 8 km·h <sup>-1</sup>	200	8.3		2.7
Poor singulation with speed 8 km·h <sup>-1</sup>	180	7.8		2.5
Planting depth – 7.6 cm (3.0 inch)	150	7.9		2.1
Planting depth - 5.0 cm (2.0 inch)	180	7.8		2.4
Planting depth - 3.8 cm (1.5 inch)	170	8.9		2.2
Pressure force on the planter row unit – auto DF mode	180	7.5		2.7
Pressure force on the planter row unit – 20 kg	150	8.4		2.2
Pressure force on the planter row unit – 200 kg	200	9.7		2.5

According to the results of the pressure force research, the highest yield of 2.7 t·ha<sup>-1</sup> was shown by the area with automatic Delta Force mode (the contact force of the row unit depth wheels with soil at level 50 kg). This can be explained by keeping the planting depth and the lack of compaction of the root zone.

According to the results of the planting depth research, the highest yield of 2.4 t·ha<sup>-1</sup> was obtained at a planting depth of 5 cm. The yield at a depth 5 cm was 0.2 t·ha<sup>-1</sup> more than at the depth of 3.8 cm and 0.3 t·ha<sup>-1</sup> more than at the depth of 7.6 cm. It could be proved by the best results of the soil moisture level and minimal loss of germination energy.

According to the results of singulation research, the best result of 2.7 t·ha<sup>-1</sup> was obtained in the area with the simulation of 96.05%, it is 0.2 t·ha<sup>-1</sup> higher than in the area with the simulation of 79.22%

The research of the yields at planting speeds for 8 and 12 km·h<sup>-1</sup> showed almost the same result of 2.7 t·ha<sup>-1</sup>, which indicates the ability to work at higher speed without losing the yield.

## Conclusions

Based on the research results of the MF 9108VE planter with Delta Force system, the following operating modes can be recommended:

- planting depth – 5 cm,
- planting speed – 12 km·h<sup>-1</sup>,
- Delta Force in automatic mode with depth wheel force to the soil 50 kg,
- singulation at the level 96%.

Such settings of the planter allow to raise productivity up to 0.4 t·ha<sup>-1</sup>.

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