Assessing the opportunities to increase economic efficiency through the use of telematic systems for analysis and control

Nedelin Markov[1*], and *Galin* Tihanov[2]

[1]Trakia University, Faculty of Economics, 6000 Stara Zagora, Bulgaria
[2]Trakia University, Faculty of Agriculture, 6000 Stara Zagora, Bulgaria

Abstract. The purpose of the study is to evaluate the possibilities for increasing production efficiency and increasing economic results through the use of modern means of real-time analysis and control. The method used is related to the implementation of a Horsch Telematics telemetry system thanks to a Horsch Connect receiver. The results show deviations in the hour of sowing events, which leads to a drop in production efficiency. By adjusting the sowing measures as a result of the reported data, it is possible to increase the economic results.

1 Introduction

The purpose of this article is to determine the influence of technological parameters of sowing on the sowing rate in precision sowing of corn by using the Horsch Telematics system. Telematics could be broadly described as data measured and viewed remotely. Limited wireless internet connectivity impedes the full utilization and effectiveness of precision agriculture practices and the subsequent agricultural big data systems. In the absence of wireless data transfer for download and upload, precision agriculture technologies such as telematics cannot be utilized efficiently [1]. The concept of precision agriculture has always been about data—particularly, site-specific decision making based on that data. To understand the evolution of precision agriculture data into "big data," one must consider how precision agriculture can be separated into information-intensive and embodied-knowledge technologies [2]. The combination of telecommunications and informatics, also known as "telematics", is of key importance for future vehicles. The research in this area is commonly included in the Intelligent Transport System (ITS) field. [3]. Moreover, many approaches which also monitor the product status by means of sensor systems can be found in the literature. These systems should take into account three key challenges for managing good: Tracking, Tracing and Monitoring (TTM). The most extended one, tracking, focuses on the ability to locate vehicles and freight at any time. Tracing allows both logistics companies and final consumers to know product movements from source to end users. Finally, the most recent challenge is monitoring, which enables logistics companies to assure product quality during transportation [4]. A variety of indicators suggest that the availability of sensors,

* Corresponding author: nedelin.markov@trakia-uni.bg

mapping technology, and tracking technologies have changed many farming systems and the management of the food system as it flows from producers to consumers [5]. In this time, many authors have reached to the conclusion that development of digital technology and applications are regarded as an important factor in their economic growth and development in the agricultural production. The improvement of mechanization of field work, machinery and equipment is a continuous process. We are witnessing the spread and agricultural use of the more and more modern equipment, which reflects to the technical and technological level of the area [6].

2 Materials and methods

The study was carried out in the month of April 2023 in the land of the town of Galabovo during the sowing of corn. The research was carried out with a Horsch Maestro 12 SV precision seed drill attached to a Claas Axion 950 tractor (Fig. 1).

Fig. 1. General view of the machine-tractor unit.

In fig. 2 shows the field where the crop was sown. The field has an area of 1500 da, and the slope of the terrain is 2.5%. Also visible from the figure are the points when the seeding unit has moved from one block to the other to sow it as well. It is also clearly seen that the field is irregularly shaped.

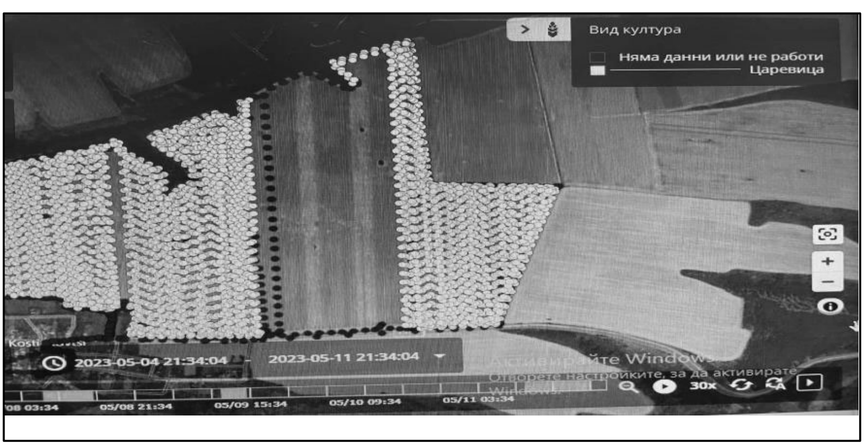

Fig. 2. Map of the plot when sowing corn.

During the sowing of the maize crop, we were given access to the Horsch Telematics telematics system by the farm agronomist. The data is downloaded from the system, imported and merged into a database. Tested areas are pre-measured and indicated in the tractor's navigation system. The sowing rate of a solution of 67,000 seeds per hectare was also determined. When sowing, the working stroke is chosen to be on the longer side of the field. The driving mode of the sowing unit is a shuttle driving mode with pear-shaped turns, and the loading mode of the planter with seed and fertilizer was done on one side of the field at the end of the turning strip. Observations were made through Horsch Telematics thanks to a Horsch Conekt receiver. Through it, a reference was made to the data of the direct seed drill in Horsch Connect Telematics. For this purpose, we used the Horsch Mobile Control app via the farmer's mobile device. Through an integrated WLAN and GPS modem, the SmartCan hardware solution connects the smartphone to the planter. The built-in memory card guaranteed us to save the data in case there was no internet coverage. Machine data and documentation can be viewed at telematics.horsch.com. Of great importance to the protection of privacy, personal data were processed in accordance with all applicable data protection laws (BGSG, EU-DS-GVO).

3 Results

The average actual operating speed during seeding ranged from 8 km/h to 11 km/h, with the average actual operating speed in the corn seeding field being 10.57 km/h. At the end of the field, the actual working speed of the machine-tractor unit "tractor-planter" decreases to 5 - 8km/h. This is completely logical, since the sowing unit is exactly where it turns. When performing the pear-shaped, symmetrical and asymmetrical turns, the actual operating speed of the unit is further reduced to 2 - 5 km/h. Also, at certain places inside, the speed is also reduced due to obstacles. These are trees, poles and remaining roots inside the field.

When sowing corn, the problems at the end of the block when turning have been solved. It is clear from practice that despite the large working width of the planter when turning, there is always a moment when we have an overtaking or lagging wing of the planter. Currently, the seeding rate of the inner sections is increased, and that of the outer sections is decreased. Therefore, to avoid such a situation with these seed drills, the Contour Farming system automatically adjusts the sowing rate when turning and distributes the seeds in a row that remains unchanged over the entire working width of the machine.

In Fig. 3 shows the set value of the sowing rate when sowing corn. From the figure it can be seen that it varies from 66000 to 69000 pcs./ha.

Fig. 3. Set value of the sowing rate

From fig. 3 it can be seen that the set value of the sowing rate is 67000 seeds per hectare. Where it is colored blue, the planter planted about 66,750 seeds per hectare and there were about 0.7% misses. Where it's yellow, that's where she doubled the seed and the seed set, and it was about 67,800 to 68,250 seed per hectare. These differences are perfectly acceptable because with an ordinary seeder we have no way to monitor these results, but here they are monitored thanks to the sensors for the flow of seeds, which are located in the sowing boots for each row. Some authors have found that there are also differences in the seeding rate for barley sowing, with 6% of the area being sown with a higher seeding rate (>200 kg/ha), which is due to replanting at the end of the levels, and the areas with a lower sowing rate than the norm (<200 kg/ha) - 5% are due to the places where the sowing unit makes turns at the end of the levels, which is accompanied by switching on and off the pneumatic seeder [7]. And in our case, to check the quality of sowing, which includes the depth of sowing and compliance with the row spacing and tillage, we took a photo, which is shown in fig. 4. At this operating speed of the unit, the cultivated area after the planter has much better indicators. It is also clear that the in-row spacing is respected and in this speed range the seeding depth is also respected.

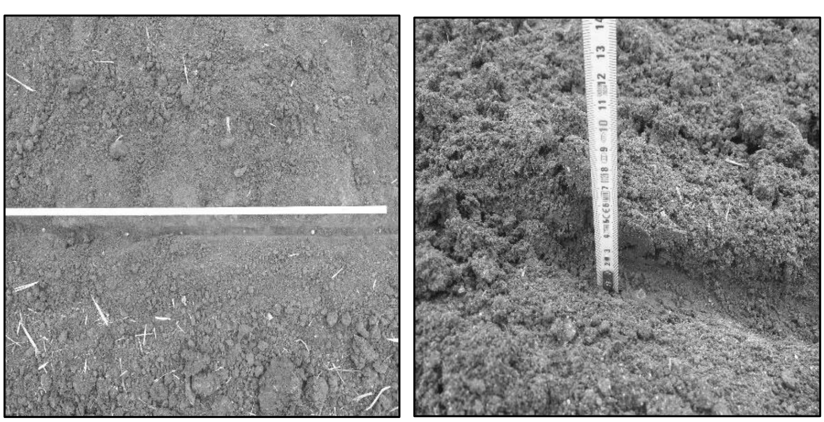

Fig. 4. Status of quality and seeding depth of maize.

In fig. 5 shows the percentage of the deviation from the set sowing rate. It can be seen that 4% of the sowing rate has increased, because the seeder in these places has doubled the seed. This can be explained by two reasons: The first reason is that in these places the scavenger rubbed out a seed, and the second reason is that the seeds were stuck together.

Fig. 5. Percentage ratio of deviation from the set sowing rate.

Also, from fig. 5 it is clear that the deviation is - 7.25 % (with the light blue color). This is due to the fact that the seed did not adhere well to the sowing disc, because there has been a loss of vacuum. In practice, there is never a planter that does not miss a single seed. A clear idea of these differences can be seen in fig. 6 a) and b), as in fig. 6 a) presents a picture of the missed places in percentages, and in fig. 6 b) the doubled places in percentages when sowing the crop.

a) b)

Fig. 6. Percentage ratio of missed and doubled seatswhen sowing corn: a) missed places; b) doubled places.

In fig. 6 a) it can be seen that the missed places when sowing corn are close to 2%. This difference is explained by the fact that exactly in these places the seeder has thrown out a seed. In this crop, the sowing disc had 30 holes and accordingly 30 seeds should be caught in its holes, but due to a strong vacuum, 29 seeds were caught, and the sweeper knocked out one seed. Also, from fig. 6 b) it is evident that the doubled places are about 3%. This is due to the fact that the planter planted two seeds in exactly these places, as the seeds were stuck together.

In fig. 7 shows the screen of the monitor after the completion of sowing, and these readings refer only to the point of sowing where it is marked on the screen.

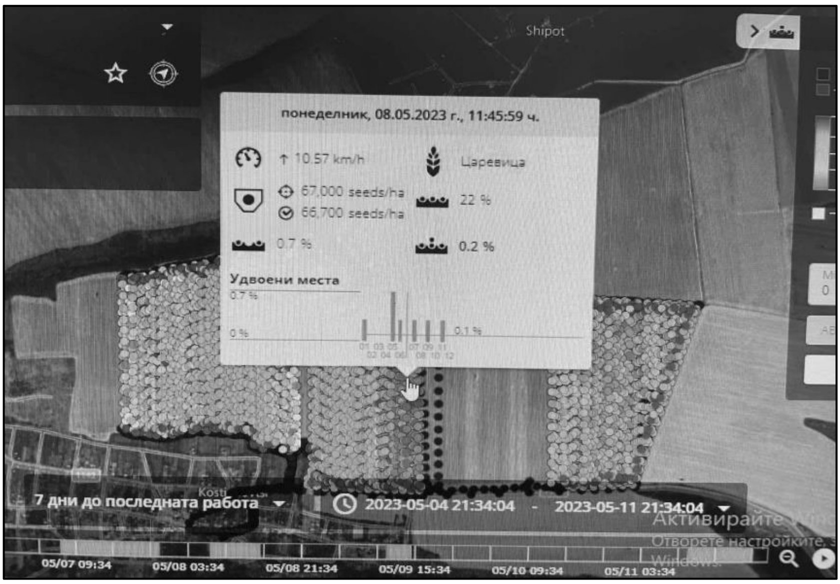

Fig. 7. Performance indicators when sowing corn

In fig. 7, it can be seen that the average actual operating speed in the corn seeding field is 10.57 km/h. It can be seen that the set seed rate is 67,000 seeds per hectare, while the actual applied rate in the field is 66,700 seeds per hectare, i.e. 99% of the sowing rate of the crop was observed. It is also seen that the percent deviation of seed omission is 0.7% with a coefficient of variation of 22%. It is very clearly visible that the percentage ratio of doubled seats 0.2 %.

4 Conclusions

The actual operating speed of the seeding unit was found to vary from 8 to 11 km/h, with the average actual operating speed when seeding in a corn field being 10.57 km/h. Also the percentage deviation from the set seeding rate, with the higher seeding rate of 4% being due to the seeder doubling the seed and the lower seeding rate of 7.25% being due to the seed not is well adhered to the bending disc due to loss of vacuum. It should be noted that due to the strong vacuum of the fan of the seeding unit, there are about 2% missed spots. It has been studied that the doubled spots in corn sowing are about 3%, which is due to the fact that the seeds were stuck together and the planter accurately in these places she has released two seeds. The results show that 99% of the sowing rate of the crop was observed, because the set sowing rate is 67,000 pieces/ha, and the actual applied rate in the field is 66,700 pieces/ha. As a conclusion, it can be noted that the Horsch planter is distinguished by a very high level of efficiency. Thanks to the telemetry system, farmers can analyze their results immediately and make appropriate adjustments. Thanks to telemetry and the development of information technology, farmers can report higher economic results, since sowing is one of the most important technological processes of growing crops and is a prerequisite for efficient agricultural production [8].

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