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EVALUATION OF TECHNOLOGICAL PERFORMANCE AND LOSS INDICES IN MECHANIZED HARVESTING OF WINTER WHEAT IN ATYPICAL VEGETATION CONDITIONS

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Abstract. *The purpose of the study is to evaluate the efficiency of the technological flow for harvesting winter wheat (Lovrin 34 variety) in the specific pedoclimatic conditions of the Răcășdia area (Caraș-Severin county), focusing on the impact of atypical climatic factors (high humidity and 90% fall rate) on the performance of high-capacity combines. The objective of the study was to estimate the productive potential, determine biological production through biometric indicators (Nsp, Nb, MMB). The research was carried out in July 2025, on an area of 240 ha, using two combines: Claas Lexion 600 and John Deere W 650. The metric frame sampling method (1 m^2) was applied to determine the density and stubble losses. The working speed was measured by the standard sector method (33 m), and the technological losses were calculated by collecting unthreshed ears and loose grains after the passage of the aggregates. Regarding the productivity results, an average production of 6108 kg/ha was obtained, with a MMB of 42 g. Kinematic indices, in fields with a slope of 90%, the actual forward speed decreased drastically to 0.422 m/s, compared to the theoretical value of 0.919 m/s, to ensure a constant mass flow. Losses during cutting, due to the absence of plant lifters on the header in lying conditions, average losses of 107.2 kg/ha were recorded. The impact of humidity, at a humidity of 23%, total losses due to unthreshed ears and poor separation ranged between 45.6 and 48.2 kg/ha. Combine performance is strongly conditioned by the vegetative state; fallen grain requires reducing the working speed by over 50% to minimize losses at the header. In high humidity conditions, it is mandatory to operate the thresher at higher speeds to compensate for the adhesion of the grains in the ear, while equipping the header with plant lifters is critical for recovering approx. 100 kg/ha in years with crop drop phenomena.*

Keywords*: wheat, evaluation, technology, harvesting*

INTRODUCTION

Global food security fundamentally depends on the stability of straw grain production, with winter wheat (Triticum aestivum) occupying a strategic position in the crop structure of Romania.

However, the efficiency of mechanized harvesting is conditioned by a series of variable factors, because, as highlighted (CUJBESCU et.al., 2021; R., BOIBOREAN, et al., 2025), the performance of modern combines is directly limited by the inhomogeneity of the crop and the extreme climatic conditions that occur during the harvest window.

In the current context of climate change, farms in the Western Plain are increasingly facing atypical meteorological phenomena.(DUMA-COPCEA A., 2021; A. DUMA COPCEA, et.al., 2024;).

Heavy rainfall during the physiological maturity period causes the plants to fall sharply, a phenomenon which, according to research carried out by (POPA D. et. al., 2015; S. BUNGESCU,

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2019;), can generate losses at the cutting device of over 10-15% even for the latest generation combines, if the forward speed is not correlated with the degree of inclination of the stems.

At S.C. Agri Trade Oravița S.R.L., the success of the campaign depends on the management of this technological flow under time pressure. (M., ȚOFEI, et. al., 2025; M., ȚOFEI, et. al., 2025).

The use of high-performance aggregates, such as the Claas Lexion 600 and the John Deere W 650, represents a cutting-edge technological solution. However, (VLĂDUȚ și colab. 2018; ILEA R., 2010, ILEA R., 2013), demonstrates that constant mass flow is essential to maintain losses below the economic threshold of 1%, any fluctuation in feed rate leading to a decrease in separation efficiency.

Furthermore, recent studies by (Scripnic V., et.al., 1980; V POP, et al., 2018, CONSTANTIN și colab. 2022) emphasizes that high biomass moisture (above 18%) acts as a factor slowing down the threshing process, requiring dynamic adjustments to the distance between the thresher and the counter-thresher.

This paper analyzes how the difficult vegetation conditions at the Răcășdia Farm — characterized by a 90% plant drop rate and high humidity — directly influence performance indicators.

The issue of header losses and separation efficiency become critical in such scenarios, requiring an adaptation of the work strategy, from modifying the feed speed (0.422 m/s) to optimizing logistics by unloading the hopper on the go. (ILEA R., et. al., 2017).

The study is based on direct experimental determinations in the 2025 campaign, providing a technical diagnosis necessary to substantiate practical recommendations regarding the adjustment of threshing systems and the efficiency of machine fleet management under climatic stress conditions.

MATERIAL AND METHODS

The studies were conducted on the Răcășdia farm, managed by S.C. Agri Trade Oravița S.R.L. (Caraș-Severin county), in the 2025 agricultural campaign.

The studied area was 240 ha, distributed in three homogeneous plots.

The seed was winter wheat, Lovrin 34 variety.

Plant fall rate of 90% and high grain moisture (23%), caused by atypical climatic conditions.

A conservative work system (minimum tillage) was implemented:

Land preparation was carried out with the John Deere 8230 aggregate + Field Boss 5000 disc harrow (without plowing).

Sowing was carried out with the Fendt 260 assembly + Horsch 6.25 seed drill (rate: 300 kg/ha).

For harvesting, two high-performance combines equipped with 9 m headers were used: Claas Lexion 600 and John Deere W 650

Methodology for determining production indices

The evaluation of biological production was carried out in the early ripening phase, using the metric frame sampling method (1 m2).

Location: 10 control points arranged on the diagonal of the field (for areas > 100 ha).

Biometric indicators analyzed:

-ear density (Nsp);

-ear fertility (Nb - grains/ear);

-1000-grain mass (MMB).

Kinematic and logistic performance determination:

-theoretical speed (vt): calculated according to the nominal feed flow rate

-real speed (vr): determined by the standard sector method (time measurement over a distance of 33 m).

-logistical efficiency: The duration of the hopper evacuation cycle was monitored in two modes: static (stationary) and dynamic (moving).

Quantification of harvest losses

The identification of losses was achieved by collecting residual material from the stubble and from the straw furrow, being classified as follows:

-header losses: ears left below the cutting height or not picked up due to the falling of the grain.

-threshing losses: grains remaining in the unthreshed ears (due to high humidity).

-separation and cleaning losses: loose grains evacuated together with the straw and chaff.

For numerical conversion into mass units, the determined value of MMB (42 g) was used, related to the standard surface of 1 m2. All data were subsequently rectified to the standard calculation humidity of 14%.

RESULTS AND DISCUSSIONS

Studies conducted on the 240 ha revealed a high biological potential for the Lovrin 34 variety, despite the difficult climatic conditions.

The production of 6,108 kg/ha demonstrates the adaptability of the Lovrin 34 variety to the pedoclimatic conditions of Caraș-Severin County. However, the high humidity of 23% at the time of harvest influenced the mass of the grains, requiring subsequent rectification of the data to the standard humidity of 14% for a real economic evaluation.

The degree of plant fall of 90% represented the main limiting factor for the working capacity of the Claas Lexion 600 and John Deere W 650 combines.

Theoretical speed (vt): 0.919 m/s (approx. 3.3 km/h) – calculated for an optimal flow.

Actual speed (vr): 0.422 m/s (approx. 1.5 km/h).

Reducing the forward speed by more than 54% was a mandatory technological measure. In the absence of plant lifters on the header, a higher speed would have led to a "crawling" effect of the plant mass and to the exponential growth of uncut ears.

This kinematic adaptation ensured a constant mass flow, preventing the threshing elements from blocking due to the large volume of wet biomass.

Losses were monitored across the three main categories, with the results highlighting the direct impact of the absence of fallen grain accessories and humidity.

Losses at the cutting device (Heder) - due to the 90% fall rate and the lack of grain lifters, average losses of 107.2 kg/ha were recorded.

This value represents approximately 1.75% of the total production, exceeding the 1% admissible threshold for this functional unit.

The ears remaining below the cutting height constitute the majority of these losses.

Losses at threshing, separation and cleaning

The 23% moisture content of the grains and straw generated cumulative losses between 45.6 and 48.2 kg/ha.

The high adhesion of the grains in the ear (caused by humidity) required the threshing machine to be set at higher speeds.

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Separation losses were kept within controllable limits thanks to the high-performance cleaning systems of the two combines, which compensated for the high specific gravity of the wet chaff.

Logistic efficiency and aggregate performance

Monitoring the duration of the evacuation cycle highlighted the importance of time management in conditions of climatic stress:

-unloading on the go (dynamic), allowed to maintain the harvesting process without interruptions, partially compensating for the reduced forward speed.

-minimum tillage system: - the use of the John Deere 8230 + Field Boss 5000 aggregate ensured a germinal bed and stubble that allowed the high-capacity combines to carry even in conditions of excessive soil moisture.

Although both combines operated under the same conditions, the Claas Lexion 600 (hybrid system) showed slightly superior threshing flow stability at 23% moisture compared to the John Deere W 650 (conventional system), although both required aggressive adjustments to the distance between the thresher and concave.

In years with heavy rainfall and falls of over 50%, the use of corn lifters is critical, being able to save approximately 100 kg/ha (approx. 1.6% of production).

In atypical vegetation conditions, the priority must be to minimize losses, not the working speed. Exceeding the threshold of 0.5 m/s in lying cornfields leads to unjustified economic losses.

The adoption of the minimum tillage system contributed not only to soil moisture retention, but also to maintaining an optimal soil bearing capacity.

This structural stability allowed the access of harvesting aggregates without causing severe compaction, despite the high humidity during the campaign.

CONCLUSIONS

Although the growing conditions were difficult, the Lovrin 34 variety demonstrated a remarkable biological production capacity, reaching an average of 6,108 kg/ha.

The 1000-grain weight (MMB) of 42 g confirms good grain filling, but the high moisture content of 23% at harvest imposed additional logistical costs for conditioning and drying.

The 90% fall rate was the determining factor in reducing working efficiency.

The actual forward speed dropped drastically to 0.422 m/s (approx. 1.5 km/h), representing a decrease of over 54% compared to the theoretical speed of 0.919 m/s.

This reduction was necessary to: - ensure a constant mass flow in the threshing units; allow the cutting device to take up the plant mass lying on the ground; avoid losses due to non-cutting and technological blockages.

The study demonstrates that losses are directly proportional to the technical equipment of the header in lying conditions:

- losses at the header: in the absence of plant lifters, average losses of 107.2 kg/ha were recorded.

These represent the largest share of total losses, being caused by the technical impossibility of the knives to cut the ears below the header clearance level.

- losses at threshing and separation: these ranged between 45.6 and 48.2 kg/ha, being influenced by the 23% humidity which increased the adhesion force of the grain in the ear and made sifting on the sieve more difficult.

Both the Claas Lexion 600 and the John Deere W 650 confirmed their status as high-performance machines, managing to handle a large volume of wet biomass. However, their performance was conditioned by rigorous dynamic adjustments (high thresher speeds and optimal concave openings).

The implementation of the bunker unloading system on the go was essential to compensate for the time lost due to the low forward speed.

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