

Impact of modern precision seed drill parameters on field germination and plant preservation of peas in the forest-steppe zone of Ukraine

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ABSTRACT

The relevance of this study is driven by the need to enhance the efficiency of pea cultivation through improved technological practices, particularly sowing, which plays a critical role in establishing uniform and productive crops. Pea plants are sensitive to deviations in sowing depth and plant density, making it essential to scientifically evaluate the effects of modern precision seed drills on field germination and plant preservation. The aim of the study was to examine the influence of precision seed drill parameters on the field germination and preservation of pea plants under the conditions of the forest-steppe zone of Ukraine. The methodology included field trials to assess plant germination and preservation prior to harvest, morphometric measurements, and statistical analysis to verify the reliability of the findings. The results demonstrated that optimal settings of a precision seed drill increased field germination rates by 6–9% compared to conventional seeders. The best outcomes were achieved with a seed embedding depth of 5 cm and a unit operating speed of 6 km/h. Under these conditions, plant preservation before harvest reached 91–93%, exceeding the control by 7–8%. Uniform seed distribution along the row reduced inter-plant competition and contributed to the formation of more consistent and productive stands. The practical value of the research lies in the potential to implement the findings in agricultural production to improve pea yields by optimising sowing parameters using modern precision seed drills.

Keywords: plant preservation, pea, sowing depth, plant density, seeding uniformity, yield.

INTRODUCTION

In modern crop production, precision sowing is a key element in the technology of growing field pea, as field germination and plant survival largely depend on it. Yatsenko et al. (2024)

demonstrate that traditional sowing methods often lead to uneven seed distribution within rows, which negatively affects plant density and crop yield. The use of precision seed drills makes it possible to achieve high accuracy of seed placement, thereby improving field germination

and plant survival. The application of precision drills ensures uniform seed distribution and precise maintenance of the required sowing depth, which positively influences plant development (Kolisnyk et al., 2025; Butenko et al., 2025).

The scientific novelty of this research lies in the comprehensive study of the effect of precision sowing on the field germination and survival of field pea plants, which will allow the development of recommendations for optimising the crop's cultivation technology. The use of precision seed drills makes it possible to achieve high accuracy of seed placement, which contributes to improved field germination and plant survival.

The application of precision drills ensures uniform seed distribution and precise adherence to the set sowing depth, which has a positive effect on plant development.

The aim of this study is to evaluate the effect of using a precision seed drill on field germination and plant survival of field pea under the conditions of the forest-steppe zone of Ukraine. The objectives of the research were as follows:

- to determine the influence of precision drill parameters on the field germination of field pea;
- to assess the effectiveness of precision drilling in ensuring plant survival until harvest;
- to compare the obtained results with traditional sowing methods.

The scientific novelty of the research lies in the comprehensive investigation of the impact of precision sowing on field germination and plant survival of pea, which will make it possible to develop recommendations for optimising the crop's cultivation technology.

METHODOLOGY

The study was conducted during the growing seasons of 2020–2024 in the forest-steppe zone of Ukraine on the experimental field of LLC *Emberika*. The object of the research was field pea (*Pisum sativum* L.) of the cultivars 'Gambit' and 'ESO', recommended for cultivation in the forest-steppe zone. The aim of the study was to determine the effect of precision drill operating parameters on field germination and plant survival of field pea at harvest.

For sowing, a precision drill Horsch Pronto 8 SW was used. This machine ensures accurate seed metering and placement with adjustable

parameters for sowing depth, seed spacing and forward speed. Sowing was carried out according to a randomised scheme with four treatments:

- sowing depth 4 cm, speed 6 km/h;
- sowing depth 5 cm, speed 6 km/h;
- sowing depth 6 cm, speed 8 km/h;
- control – mechanical seed drill SZ-3.6, sowing depth 5 cm, speed 7 km/h.

The plot size was 25 m², with three replications. The soil of the experimental site was typical medium-humus chernozem.

Field germination was determined 10 days after sowing by counting the number of emerged plants within the row on a fixed area. Plant survival was assessed before harvest by recounting the number of plants on the same plots. For morphometric evaluation, plant height, number of nodes and number of pods were measured.

The results were statistically processed using analysis of variance with calculation of mean values, standard errors, and the significance of differences between treatments. Data processing was performed using Microsoft Excel and Statistica 12 software.

Agro-meteorological conditions during the growing season were monitored daily based on data from the nearest meteorological station.

The soils of the experimental site were typical medium-humus chernozems with a humus content of 4.1%, pH 6.8, medium nitrogen supply, and high phosphorus and potassium availability. Prior to setting up the experiment, the field was levelled and spring pre-sowing tillage was performed according to standard technology. The preceding crop was winter wheat.

Sowing was carried out with the precision drill Horsch Pronto 8 SW, which enables highly accurate seed metering, maintenance of the set sowing depth and row spacing, as well as adjustment of forward speed. The operating parameters of the drill were set in accordance with the experimental design. For control, a standard mechanical seed drill SZ-3.6 was used.

Agro-meteorological conditions during the study period were characterised by moderate precipitation and average daily air temperatures close to long-term values. The mean air temperature in May was +16.8 °C with 48 mm of rainfall, providing favourable conditions for seed germination and early pea growth.

Thus, the experimental base of the research was sufficiently equipped to ensure the accuracy of

the experimental work, and the natural conditions allowed an objective assessment of the influence of precision drill parameters on field germination and plant survival of field pea.

The object of the research was field pea (*Pisum sativum* L.) of medium-ripening cultivars ‘Gambit’ and ‘ESO’, recommended for cultivation in the forest-steppe zone of Ukraine. The studied cultivars are characterised by stable yield performance, high germination energy, good adaptability to environmental conditions, and resistance to lodging. Prior to sowing, the pea seed was calibrated and treated in accordance with the manufacturer’s recommendations.

The following main materials and technical equipment were used in the study:

- precision drill Horsch Pronto 8 SW – a modern high-performance seed drill that enables precise seed metering by depth and intra-row spacing, equipped with electric drives and real-time sowing control systems;
- control seed drill SZ-3.6 – a mechanical grain drill of traditional type, commonly used on farms for sowing cereals and grain legumes;
- pea seed of the cultivars ‘Gambit’ and ‘ESO’, certified, with laboratory-confirmed quality indicators (germination – 96%, purity – 99%, 1000-seed weight – 240 g);
- mycorrhizal preparation Mycofrend (1.2 kg/ha); inoculants – Nitrofix (1 L/t) and Rizoaktiv Bobovi (1 L/ha);
- equipment for agrochemical soil analysis (pH meters, photometers, reagents for determining nutrient content);
- measuring instruments: measuring tapes, calipers, thermometers, scales for yield mass determination;
- computer equipment and software (Microsoft Excel, Statistica 12) – for data processing, statistical analysis, and graph construction.

All materials used in the study were selected in accordance with the aim of the experiment, taking into account modern requirements for the accuracy of field research and the possibility of scaling the results under production conditions.

RESULTS AND DISCUSSION

The main factor influencing plant growth, development, phytosanitary status, and ultimately high yield formation, is the number of plants per

unit area. Field germination and plant density are significantly affected by varietal characteristics, agrotechnical practices, soil and weather conditions (Didur and Bandrovsky, 2024). For germination, pea seed requires a high amount of soil moisture; if sowing is delayed even by 7–10 days, soil moisture decreases considerably. As a result, the seeds imbibe unevenly, emergence becomes irregular, and yield potential is substantially reduced (Gamayunova, and Yermolaev, 2024; Kolisnyk et al., 2025).

Microbial inoculants have a positive effect on the growth and development of crops. These biological preparations contain beneficial microorganisms capable of stimulating plant growth and improving the agrobiological properties of the soil. They are an integral part of biotechnologies in modern agriculture (Khomina, et al., 2024). The use of precision drills for field pea sowing is an important direction of modern farming, since the optimisation of sowing parameters improves field germination and plant survival before harvest (Vakhnyak et al., 2025).

Effect of sowing depth. Sowing depth is one of the key factors influencing germination energy, uniformity of emergence, tolerance to adverse conditions, and ultimately field pea yield (Kolesnikov et al., 2024). Research indicates that the optimal sowing depth for pea is 50–75 mm. Excessively deep sowing (> 76 mm) may reduce germination and yield. However, under dry conditions, deeper sowing may be necessary to ensure sufficient contact of the seed with moist soil (Johnston and Stevenson, 2001, Okrushko et al., 2025; Petrychenko et al., 2025).

Effect of plant density. Optimal plant density for pea depends on the region and growing conditions. North American studies recommend a density of 70–90 plants/m² in northern regions and 86–108 plants/m² in warmer areas. Higher plant populations can reduce weed competition and increase yield, but they also raise seed costs (Bahan et al., 2024).

Use of inoculants. Seed inoculation with *Rhizobium leguminosarum* bv. *viciae* enhances nitrogen fixation from the atmosphere. However, inoculant effectiveness may depend on whether peas have been previously cultivated in the soil, as earlier crops can provide sufficient bacterial populations for inoculation (Tkachuk et al., 2024; Tkachuk et al., 2025).

Use of precision drills. Modern precision drills enable accurate control of sowing depth and

density, ensuring uniform seed distribution and improved field germination. This is particularly important for peas, since uniform sowing reduces plant competition and increases resource-use efficiency (Thiyam et al., 2017).

Optimising sowing parameters of pea, particularly depth and density, using precision drills is a key factor for improving field germination and plant survival. The application of such technologies makes it possible to achieve high yield performance and production efficiency.

The field experiment was established in the spring of 2024 in accordance with the standard methodology for conducting crop science trials. The research was carried out on an experimental field in the Forest-Steppe zone of Ukraine using a randomised design with three replications. The stages and procedure of the experiment were as follows:

Soil preparation. Prior to sowing, pre-sowing tillage was performed, including field levelling, moisture retention, cultivation and harrowing. The preceding crop was winter wheat. Agrochemical soil indicators were determined: medium nitrogen content, high phosphorus and potassium supply, pH – 6.8.

Seed preparation. Field pea seed of the cultivars ‘Gambit’ and ‘ESO’ was used. The seed was pre-calibrated, tested for germination (96%), and treated with a fungicide preparation in accordance with agrotechnical recommendations.

Experiment establishment. The experiment was laid out with the following treatment scheme:

- Variant 1 – sowing depth 4 cm, speed 6 km/h (Horsch Pronto 8 SW);
- Variant 2 – sowing depth 5 cm, speed 6 km/h (Horsch Pronto 8 SW);
- Variant 3 – sowing depth 6 cm, speed 8 km/h (Horsch Pronto 8 SW);
- Variant 4 (control) – sowing depth 5 cm, speed 7 km/h, drill SZ-3.6.

Row spacing was 15 cm, and the plot size was 25 m². Sowing was carried out under favourable weather conditions, with soil temperature at sowing depth ranging from +8 to +10 °C.

Observations and recording. Ten days after sowing, field germination was assessed by counting the number of emerged plants on a controlled row area. During the growing season, plant development dynamics were recorded, and biometric parameters were determined, including plant height, height of the first pod attachment, number

of nodes, stems, and leaf surface condition. Before harvest, plant survival was determined as the ratio of the number of plants at harvest to the number of plants that had emerged.

Harvesting and data processing. Grain yield was determined by weighing the dry seed mass from the accounting plots, recalculated per hectare. The data were statistically processed, with mean values, standard deviations, and the significance of differences between treatments determined using analysis of variance. All field and laboratory work was performed in accordance with methodological guidelines for scientific research in crop production.

Various types of seed drills are used for pea sowing, depending on the requirements of modern agricultural production. Innovative seed drills can increase sowing efficiency and accuracy, reduce seed and fuel consumption, and enhance both the quality and quantity of yield.

The choice of specific equipment depends on many factors, such as farm size, soil type, climatic conditions, and budget. Having analysed innovative technologies for pea cultivation in modern agricultural production, as well as some popular brands and models of seed drills for peas, we selected the Horsch Pronto 8 SW – a versatile seed drill capable of precise sowing and simultaneous fertiliser application (Hrushetskyi et al., 2025; Petrychenko et al., 2025). It is renowned for its high productivity and accuracy of seed placement. The machine features a depth control system to ensure optimal germination conditions. The innovative functions of this machine may include:

- automation of processes: monitoring all stages of sowing, including seed depth and spacing;
- precise fertiliser application control: simultaneous incorporation of micro- and macronutrients during sowing;
- GPS systems: for accurate monitoring and optimisation of machinery performance;
- fuel and seed savings: modern seed drills minimise seed losses and use resources efficiently.

Table 1 presents the technical specifications of the precision seed drill Horsch Pronto 8 SW. Grain seed drill Horsch Pronto 8 SW and its advantages over others:

- versatility of use: suitable for sowing under minimum tillage, after ploughing, or for direct drilling;
- high-speed sowing: the Pronto enables sowing at high speeds while consistently maintaining excellent seed placement quality thanks to its

Table 1. Technical specifications of the modern precision seed drill Horsch Pronto 8 SW (Hrushetskyi et al., 2025)

Parameter	Value
Working width (m)	8.00
Transport width (m)	3.00
Transport height (m)	3.95
Transport width without/with SW (m)	8.50 / 15.50 with SW 12,000 SD
Weight without/with SW (kg)	9.060 / 12.520 with SW 12.000 SD
Capacity of two-section hopper (L)	12,000 (50:50)
Dimensions of loading openings, two-section hopper (m)	0.99 × 0.72
Loading opening of two-section hopper (m)	3.35
Number of PPF coulters	26
Coulter pressure force PPF (kg)	max. 200
Number of seed coulters	52
Coulter pressure force (kg)	5–120
Sowing coulters / press rollers (cm)	34 / 32
Row spacing (cm)	15.4
Tyre packer size	7.50–16 AS
Tyre packer (cm)	78
Working speed (km/h)	10 – 20
Power requirement (kW / hp)	155–215 / 210–290
Hydraulic connections (DW-sections)	2
Low-pressure return line (max. 5 bar)	1
Oil consumption of hydraulic fan (L/min)	50–60
Tractor coupling: drawbar with eye	Pins 50–55 and 60–70 mm

unique packer system, which ensures perfect levelling with high field capacity. This effectively prevents wave formation in the micro-relief of the field;

- large-capacity seed and fertiliser hopper: reduces the number of refills and increases overall productivity;
- pre-sowing soil consolidation: an essential condition for optimal seed germination, even under conditions of moisture deficit or excess, which is particularly relevant in current climatic conditions;
- TurboDisc double-disc coulter with scraper and seed placement system: prevents blockages even under the most challenging conditions, ensuring consistently high-quality seed placement and uniform emergence, which in turn secures maximum yield;
- ease of adjustment: central regulation of soil preparation blocks, packers, and sowing units. Uniform sowing depth across the field is achieved thanks to the designed vertical offset between the packer and coulter units;
- targeted fertiliser placement (PPF system): deposits fertilisers in the interrow, below the

seed horizon. Working width of the seed drills ranges from 3 to 12 m.

The ability of sown seeds to germinate well under field conditions and produce normally developed seedlings at micro-stages BBCH 09–10 is referred to as field germination. Field germination is a key indicator reflecting the viability of seeds under real conditions (Didur et al., 2020; Mazur et al., 2025; Mostovenko et al., 2025).

For pea, as a valuable food, fodder, and crop rotation plant, it is important to use seed with high field germination (not less than 85–90%), which is a guarantee of stable yield and efficient use of resources (Chinchyk, et al., 2023). High field germination ensures uniform stands, which simplifies crop management (soil cultivation, fertiliser application, plant protection) and provides uniform pod maturation (Bakhmat and Zagnitko, 2024). Well-germinated and evenly spaced plants quickly close the rows, suppressing weeds and reducing the need for herbicides.

Results of studies conducted during 2020–2024 showed that the field germination of the pea cultivar ‘Gambit’ was lower than that of the

cultivar ‘ESO’ in all experimental variants (Table 2, Figure 1, Figure 2).

Thus, in the control variant (sowing depth 5 cm, speed 7 km/h, SZ-3.6 seed drill), field germination was the lowest, amounting to 89.0% for the pea cultivar Gambit and 92.1% for the cultivar ESO. Under the influence of the mycorrhizal preparation Mycofriend, which contains live cultures of endo- and ectomycorrhizal fungi that form a symbiosis with the plant root system, seeds germinated and developed better, with field

germination increasing to 93.3% and 96.8%, respectively. Slightly higher values were observed in variants treated with the inoculants Nitrofix and Rizoaktiv Bobovi: 95.1–94.2% for the pea cultivar Gambit and 96.0–96.3% for the cultivar ESO. It is known that field germination is directly correlated with yield potential: the greater the number of fully developed plants in the field, the higher the possible yield. Over an average of five years of research, a positive effect on field germination and plant density was observed from seed treatment with the

Table 2. Parameters of field germination in field pea crops depending on agrotechnical practices, % (mean for 2020–2024)

Factor A	Factor B	I*	II*	III*	IV*
Gambit	Control	91.0	93.1	93.0	89.0
	Mycofriend	94.8	96.8	96.0	93.3
	Mycofriend + Nitrofix	96.7	97.9	97.2	94.6
	Mycofriend + Rizoaktiv Bobovi	97.5	98.6	98.4	96.0
	Nitrofix	96.4	97.2	96.5	95.1
	Rizoaktiv Bobovi	96.9	98.1	97.8	94.2
ESO	Control	93.6	94.3	94.1	92.1
	Mycofriend	96.9	98.0	97.8	96.8
	Mycofriend + Nitrofix	97.8	98.6	98.3	97.2
	Mycofriend + Rizoaktiv Bobovi	98.9	99.5	99.0	98.8
	Nitrofix	96.8	97.5	97.1	96.0
	Rizoaktiv Bobovi	98.6	97.8	98.3	96.3

Note: * I – turning depth 4 cm, speed 6 km/h (Horsch Pronto 8 SW); II – turning depth 5 cm, speed 6 km/h (Horsch Pronto 8 SW); III – turning depth 6 cm, speed 8 km/h (Horsch Pronto 8 SW); IV – depth 5 cm, speed 7 km/h, SZ-3.6 seeder (control).

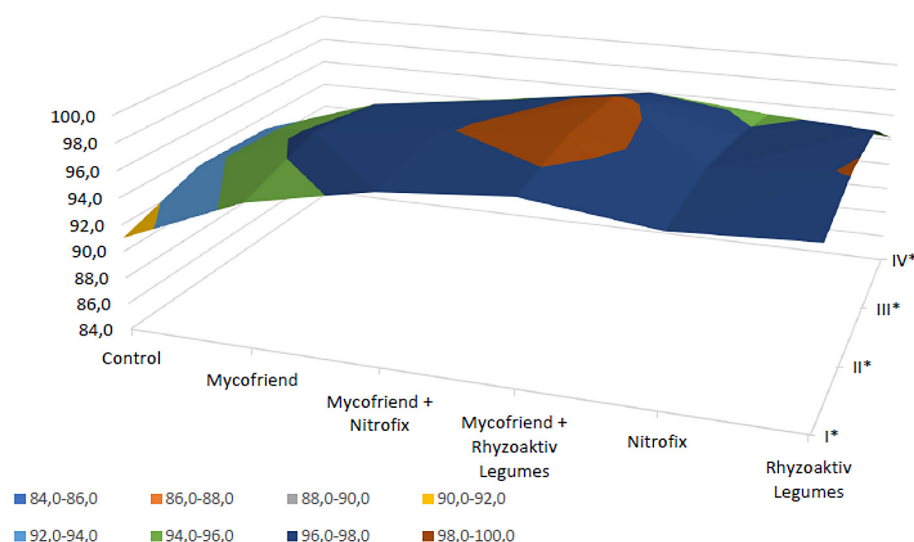


Figure 1. Dynamics of field germination in seed pea crops, variety – gambit, % (2020–2024), * I – seeding depth 4 cm, speed 6 km/h (Horsch Pronto 8 SW); II – seeding depth 5 cm, speed 6 km/h (Horsch Pronto 8 SW); III – seeding depth 6 cm, speed 8 km/h (Horsch Pronto 8 SW); IV – depth 5 cm, speed 7 km/h, seeder SZ-3.6 (control)

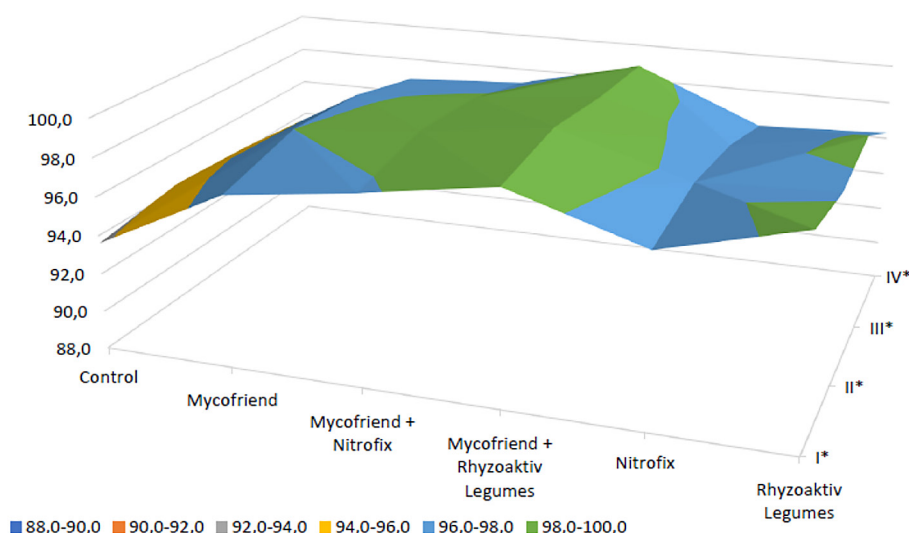


Figure 2. Dynamics of field emergence in common pea (*Pisum sativum* L.) depending on agronomic practices, variety 'ESO', % (2020–2024), * I – seeding depth: 4 cm, speed: 6 km/h (Horsch Pronto 8 SW); II – seeding depth: 5 cm, speed: 6 km/h (Horsch Pronto 8 SW); III – seeding depth: 6 cm, speed: 8 km/h (Horsch Pronto 8 SW); IV – seeding depth: 5 cm, speed: 7 km/h, seeder: SZ-3.6 (control treatment)

biological preparations Mycofriend, Nitrofix, and Rizoaktiv Bobovi. Field germination of pea plants in the variant with a sowing depth of 5 cm using the Horsch Pronto 8 SW seed drill at a speed of 6 km/h was superior compared to variant III (sowing depth 6 cm, speed 8 km/h, Horsch Pronto 8 SW) and variant I (sowing depth 4 cm, speed 6 km/h, Horsch Pronto 8 SW). The highest field germination rates were recorded in variants where the preparations Mycofriend + Nitrofix and Mycofriend + Rizoaktiv Bobovi were applied. For example, sowing depth 5 cm with the SZ-3.6 seed drill at a speed of 7 km/h resulted in 94.6 % and 96.0 % field germination for the Gambit cultivar and 97.2% and 98.8% for the ESO cultivar, respectively. After seed treatment with the inoculant Nitrofix in combination with the mycorrhizal preparation, these values were slightly lower: 96.6% and 98.0%, respectively, which is 3.9–4.6% higher than in the control variant. When using inoculants without mycorrhizal stimulation – that is, without a close connection between plant roots and fungal mycelium, which enhances nutrition, growth, and stress resistance – field germination was somewhat lower compared to the combination of Mycofriend + Nitrofix and Mycofriend + Rizoaktiv Bobovi.

The formation of stand density in field pea is a complex agrotechnical process, which includes selecting the optimal seeding rate, ensuring high field germination, and creating favourable conditions for seedling emergence and plant development (Mazur et al., 2021). For each pea

cultivar, these parameters may vary slightly depending on its biological characteristics, cultivation zone, and tillage technology (Nebaba et al., 2025). Field germination is a key factor affecting the actual density of seedlings (Drobitko et al., 2025; Lys et al., 2025). High field germination in our studies enabled achieving maximum plant density per m². Accordingly, due to lower field germination in the control variant (sowing depth 5 cm, speed 7 km/h, SZ-3.6 seed drill), the stand density at micro-stages BBCH 12–13 was lower compared to other years, ranging from 106.8–110.5 plants/m² depending on the cultivar (Table 3, Figure 3, Figure 4).

Seed treatment of peas with the preparation Mycofriend contributed to better crop formation and provided a stand density of 116.2 plants/m² for the ESO cultivar and 111.9 plants/m² for the Gambit cultivar on plots with a sowing depth of 5 cm and a speed of 6 km/h (Horsch Pronto 8 SW). In variants where the combination of Mycofriend + Nitrofix was applied, the stand density of the field pea cultivar Gambit ranged from 113.5 to 116.6 plants/m². Excessive plant density can lead to lodging, competition for light, and increased susceptibility to diseases. Conversely, too low a density may result in yield losses due to underutilisation of the nutrient area (Koeshall et al., 2022; Didur and Pansyryeva, 2025; Hetman et al., 2025). In our studies conducted from 2020–2024, plant density per m² was optimal for the growth and development of field pea plants. The best values were recorded

Table 3. Parameters of stand density formation of field pea plants at micro-stages BBCH 12–13 depending on agrotechnical factors, plants/m² (2020–2024)

Factor A	Factor B	I*	II*	III*	IV*
Gambit	Control	109.2	111.7	111.6	106.8
	Mycofrend	113.8	116.2	115.2	111.9
	Mycofrend + Nitrofix	116.0	117.5	116.6	113.5
	Mycofrend + Rizoaktiv Bobovi	117.0	118.3	118.1	115.2
	Nitrofix	115.7	116.6	115.8	114.1
	Rizoaktiv Bobovi	116.3	117.7	117.4	113.0
ESO	Control	112.3	113.2	112.9	110.5
	Mycofrend	116.3	117.6	117.8	116.2
	Mycofrend + Nitrofix	117.4	118.3	117.9	116.6
	Mycofrend + Rizoaktiv Bobovi	118.7	119.4	119.3	118.6
	Nitrofix	116.2	117.0	116.5	115.2
	Rizoaktiv Bobovi	118.3	117.4	116.8	115.6

Note: I – turning depth 4 cm, speed 6 km/h (Horsch Pronto 8 SW); II – turning depth 5 cm, speed 6 km/h (Horsch Pronto 8 SW); III – turning depth 6 cm, speed 8 km/h (Horsch Pronto 8 SW); IV – depth 5 cm, speed 7 km/h, SZ-3.6 seeder (control).

for both cultivars in variant II (sowing depth 5 cm, speed 6 km/h, Horsch Pronto 8 SW) on plots treated with the mycorrhizal preparation and the inoculant Rizoaktiv Bobovi: 117.5 plants/m² for the Gambit cultivar and 119.4 plants/m² for the ESO cultivar, which is 6.2–6.6 plants/m² higher than the control variant.

In the variant with a sowing depth of 4 cm and speed of 6 km/h (Horsch Pronto 8 SW), stand density of the studied pea cultivars ranged from 109.2 to 112.3 plants/m² depending on the cultivar. Application of Mycofrend improved stand formation by an average of 3.6–4.9 plants/

m². The highest stand densities were recorded in plots where seeds were treated with Mycofrend in combination with inoculants, reaching 116.0–118.1 plants/m² for the Gambit cultivar and 117.4–119.3 plants/m² for the ESO cultivar.

Throughout 2020–2024, the average number of viable pea plants per m² formed after seed germination ranged from 109.9–117.1 plants for the Gambit cultivar and 112.1–118.9 plants for the ESO cultivar. The effect of the mycorrhizal preparation and seed inoculation before sowing had a positive impact on the dynamics of stand density formation. Out of 120 seeds/m² sown for

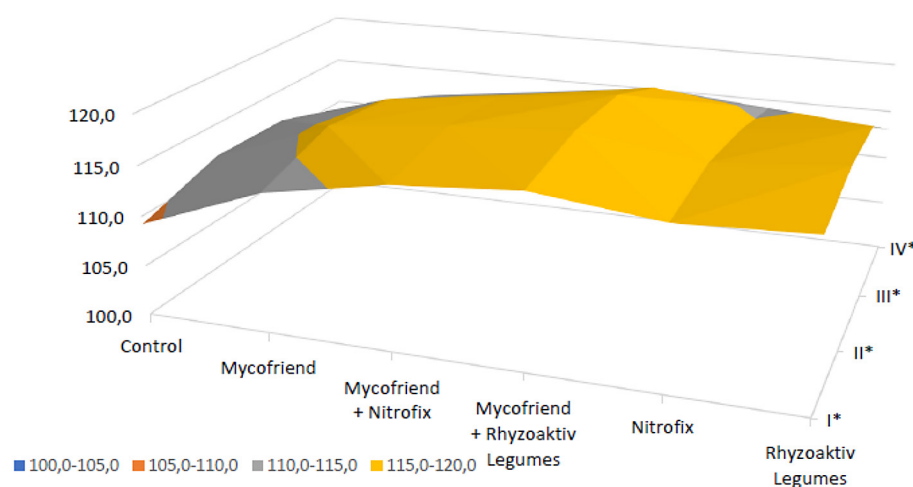


Figure 3. Dynamics of plant density formation in common pea (*Pisum sativum* L.), variety ‘Gambit’, at BBCH stage 12–13 depending on agronomic practices, plants/m² (2020–2024); I – seeding depth: 4 cm, speed: 6 km/h (Horsch Pronto 8 SW); II – seeding depth: 5 cm, speed: 6 km/h (Horsch Pronto 8 SW); III – seeding depth: 6 cm, speed: 8 km/h (Horsch Pronto 8 SW); IV – seeding depth: 5 cm, speed: 7 km/h, seeder: SZ-3.6 (control treatment)

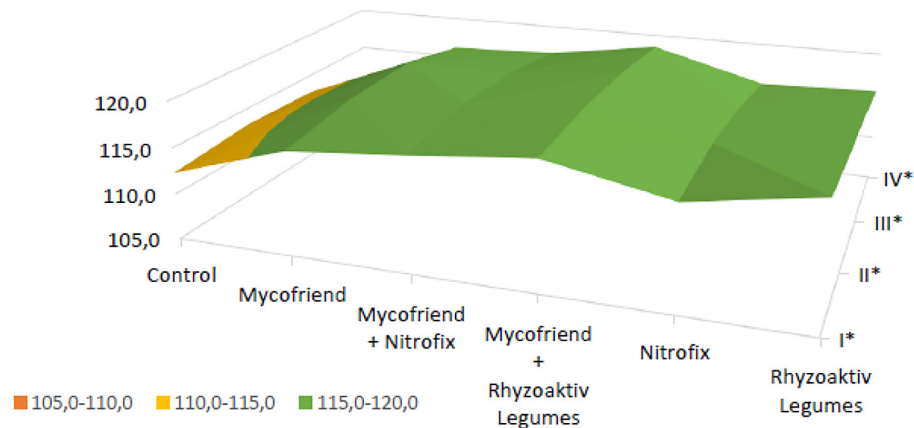


Figure 4. Dynamics of plant density formation in common pea (*Pisum sativum* L.), variety ‘Gambit’, at BBCH stage 12–13 depending on agronomic practices, plants/m² (2020–2024); I – seeding depth: 4 cm, speed: 6 km/h (Horsch Pronto 8 SW); II – seeding depth: 5 cm, speed: 6 km/h (Horsch Pronto 8 SW); III – seeding depth: 6 cm, speed: 8 km/h (Horsch Pronto 8 SW); IV – seeding depth: 5 cm, speed: 7 km/h, seeder: SZ-3.6 (control treatment).

the Gambit pea cultivar on plots treated with this combination of preparations, 117.1 plants/m² germinated and were established, while for the ESO cultivar, 118.9 plants/m² were formed.

Stand density formation is the result of the interaction between agronomic practices, seed quality, and environmental conditions. To achieve the desired stand density, it is necessary to ensure the use of high-quality seed, proper soil preparation, optimal sowing dates and depth, and protection of seedlings at early stages. Rational formation of plant density is the foundation of a highly productive agroecosystem.

CONCLUSIONS

Modern technologies in seeding equipment ensure high-quality sowing operations, which increase crop yields and reduce production costs. In particular, the use of GPS navigation and automatic control allows for more precise sowing. Furthermore, advanced seeding units can be equipped with sensors to monitor soil moisture, enabling optimized water and fertiliser application. Some models can even operate on solar power, making them more environmentally friendly and cost-effective. Overall, modern seeding equipment is an essential tool for improving agricultural productivity and efficiency while reducing the environmental impact of farming. The application of these technologies ensures more accurate and economical sowing, higher yields, and lower cultivation costs. The results of the study demonstrated that the operational

parameters of a modern precision seed drill have a significant impact on field germination and plant survival of pea crops. The best results were recorded at a sowing depth of 5 cm and a drill speed of 6 km/h: field germination reached 91%, and plant survival until harvest – 93%. Compared to a traditional drill (SZ-3.6), these indicators were 6–8% higher, highlighting the high efficiency of precision sowing technology.

The study also showed that the correct selection of sowing parameters promotes the formation of an even stand, reduces intraspecific competition, and provides optimal conditions for plant growth and development. This, in turn, positively affects productivity levels and the economic feasibility of pea cultivation. It was established that the use of a precision seed drill not only improves germination and plant survival but also ensures stability of agronomic processes under variable weather conditions.

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