UDK 631.531.12

Shupilov A. A., *PhD, Assoc. Prof.*, ***Garba M. B.***, *MSc. Eng. Graduate student*
Belarusian State Agrarian Technical University, Minsk

PARAMETERS VALIDATION OF SEEDER FOR SOWING SEEDS OF VEGETABLE CROPS IN TRAYS WITH DRUM-VACUUM DEVICE

Abstract. This paper presents design of drum-vacuum seeding apparatus in cell trays. Working and design parameters that provide optimum quality of vegetable seeds singulation in cell trays are substantiated.

Keywords: vegetables, seeds, seeding mechanism, seeder, tray

Аннотация. Предложена конструкция барабанно-вакуумного высевающего аппарата установки для высева семян в кассеты. Обоснованы технологические и конструктивные параметры барабанно-вакуумного аппарата, обеспечивающих требуемое качество однозернового высева семян овощных культур в кассеты.

Ключевые слова: овощи, семена, высевающий аппарат, установка, кассета

As a result of analysis on conventional tray seeding machines [1, 2], the seeding mechanisms are classified according to their design and principle of operation. The widespread use of tray technology in the production of seedlings causes the urgency of research on the further study and improvement of the seeding units' design for single-seeding.

A drum-vacuum seeding device has been developed (fig. 1) and studies have been carried out to justify its rational parameters. The machine dibbles holes in the substrate located in the tray cells, seed picking and placing of seed in the dibbled holes is achieved with this machine.

This study was intended to investigate the influence of vacuum created in the drum and the suction holes diameter on the technological process of sowing cabbage seeds in tray. The obtained results made it possible to determine the mathematical dependence of this influence on the quality of seed sowing and to optimize the parameters of the sowing device.

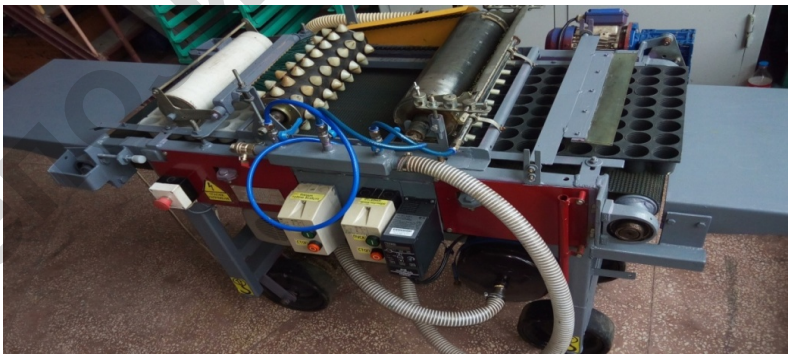


Figure 1 - General view of the experimental seeding machine with a drum-vacuum device

MATERIALS AND METHODS

The seeds used in this test were cabbage known as Valentina cultivar obtained from a unitary enterprise "Agro-complex Dzanovichi" in Minsk. The study considered the vacuum pressure in the drum (x1) and the suction hole diameter (x2) as the experimental factors.

In order to study the quality of the seeding process [3], the second order (quadratic) orthogonal central compositional design (OCCD) for two factors was used [4, 5]. The following application packages were used to process the results of the experiment: *Statistica 7.0 (Stat Soft)* (for randomization of the order of conducting experiments); *Microsoft Excel* (for result processing of the quadratic OCCD; *MathCAD Prime 3.0* (for investigating regression equations and constructing the response surface). After the implementation of the experiment plan, the regression coefficients of the model were determined according to the procedure [6]. A two-dimensional cross-section technique was used to study the regression equations [7].

The quality of the seeding process in the tray is determined by the presence of one seed in the center of the dibbled holes in the substrate of each cell of the tray. Optimization was carried out to determine the values of variable factors for sowing seeds with the least number of empty cells and double seeds. Consequently, the seeding quality of the drum-vacuum sowing device was evaluated by attaining maximum number of single-seed cells in the trays.

The coding of factor levels is presented in table 1.

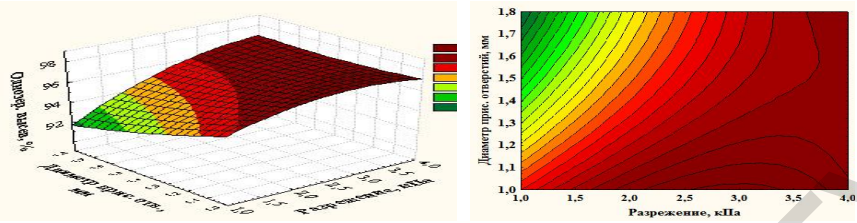
Table 1 - Levels of factors variation in the experimental design for the study of the seeding mechanism

Factors	X_1	X_2
	Vacuum created in the drum, kPa	Diameter of suction holes, mm
Main level (X_{i0})	2,5	1,4
Variation interval (ΔX_i)	1,5	0,4
Upper level (x_i =1)	4,0	1,8
Lower level (x_i=-1)	1,0	1,0

RESULTS AND DISCUSSION

In accordance with the chosen scheme, 9 experiments were performed in four replicates. As a result, regression equation was obtained to determine the number of cells with a single-grain seeding (Y), depending on the magnitude of the variable factors:

$$Y = 61{,}19 + 1{,}04\left(\frac{p-2{,}5}{1{,}5}\right) - 0{,}67\left(\frac{d-1{,}4}{0{,}4}\right) + 0{,}63\left(\frac{p-2{,}5}{1{,}5}\right) * \left(\frac{d-1{,}4}{0{,}4}\right) - 0{,}71\left(\frac{p-2{,}5}{1{,}5}\right)^2$$



а) *б*)

Figure 2 - Graph (a) and a two-dimensional section (b) of the response surface, characterizing the percentage of single-seed sowing by the vacuum created in the drum and the diameter of the suction holes

Model adequacy validity based on F-test at 5% significance level showed that the model is adequate, since $F_{calc.} = 1{,}241 < F_{tab.}$; ($F_{0.05} = 5.759$).

In order to analyze the regression equation, the corresponding response surface and its two-dimensional cross section were plotted in figure 2. Based on the analysis of the plotted graphs, the following conclusions are drawn:

Single-seeding could be attained with a vacuum $p \approx 3.0$ kPa and the diameter of suction holes $d = 1{,}0$ mm. Therefore, to achieve the maximum number of cells with a single-seeds at least Y = 61.19 cells (not less than 97.6%), the optimum values of the factors are within the following: vacuum $p = 2.9 \ldots 3.0$ kPa, the diameter of the holes d = 1.0 ... 1.2 mm.

Conclusion

The design of a drum-vacuum seeder for sowing seeds of vegetable crops in trays is proposed. As a result of the laboratory tests, the rational technological and design parameters of the seeding machine were determined, under which the maximum number of cells with a single-seed seeding in the trays is achieved (Y = 61.2 cells or 98%): the vacuum created in the drum cavity $p \approx 2.9 \ldots 3{,}0$ kPa; diameter of suction holes d ≈ 1.0 ... 1.2 mm; conveyor belt speed $v_t = 2.4$ m/min → const.

References

1. Si, H. P. et al., Summary of the Developing Status of Greenhouse Tray Seeder and Seed Metering Device // Applied Mechanics and Materials. 2013. Vol. 387. P. 271-279.

2. Wu, R. et al., The Research and Application of Seeding Machine's Dislocation Type Seeding Device //, Advanced Materials Research. 2013. Vols. 605-607. P. 324-327.

3. Lavruhin, P. V. Assessment and comparison of single-seed sowing precision. [Electronic resource]: http://livesafety.ru/content/articles/1127/. Retrieval date: 08.09.2017.

4. Leonov, A. N. et al. Fundamentals of scientific research in examples and exercises. Minsk, BSATU, 2013. 133 p.

5. Leonov, A. N. et al. Fundamentals of scientific research and modeling: test tasks. Minsk, BSATU, 2013. 80 p.

6. Novik, F. S., Arsov, Ya. B. Optimization of metal technology processes by experimental design methods. Moscow, Engineering: Technika, 1980. 304 p.

7. Melnikov, S. V., Aleshkin V. R., Roschin. Experimental design in research on agricultural processes. Leningrad, Kolos, 1980. 168 p.

УДК 637.1

***Станкевич И.И.**, ст. преподаватель*
УО «Белорусский государственный аграрный технический университет», г. Минск

ОСОБЕННОСТИ ФОРМИРОВАНИЯ МОЛОЧНЫХ КЛАСТЕРОВ В РЕСПУБЛИКЕ БЕЛАРУСЬ

Ключевые слова: молочный кластер, предприятие, холдинг

Аннотация: В статье рассмотрены особенности формирования молочных кластеров и разработаны рекомендации по их созданию, рассмотрены действующие в Республике Беларусь молочные холдинги.

Динамика внешней бизнес-среды, сложность конкуренции и высокие трансакционные издержки вызывают у предприятий необходимость в укрупнении их форм, объединении, диверсификации их деятельности. Образование новых организационных форм, в том числе, является способом снижения совокупных издержек и рисков, установления долговременных связей, что в свою очередь может позволить предприятию заняться инновационной деятельностью, от которой отказывались из-за присущей ей неопределенности, а в некоторых случаях толкает их к этому. Ведь в этом случае, можно окупить инвестиции в создание систем риск-менеджмента. В результате возникают группы предприятий (холдинги, финансово-промышленные группы, концерны, консорциумы), происходят слияния, поглощения и так далее. Интеграционные процессы охватывают не только производственные функции (технологические цепочки, использование инноваций), но и коммерческие (сбыт, закупки), финансовые (инвестиционное кредитование, размещение ценных бумаг и т.д.) и прочие.

Такие процессы вызваны еще и причинами высокого морального и физического износа основных фондов, неспособностью продуктов производства многих отраслей промышленности конкурировать с зарубежными аналогами.

Процессы объединения привели к появлению в 1920-х годах синдикатов и трестов, во второй половине XX века возникли объединения на базе научно-технических центров. В конце 80-х годов стали появляться межотраслевые государственные объединения, преобразованные позднее в ходе приватизации в акционерные общества.

Основными мотивами, доминирующими при создании кооперативных и интегрированных структур являются следующие: экономия на масштабе производства; экономия на масштабе сферы деятельности; экономия на трансакционных издержках.