OPTIMUM PLANNING OF BASIC PARAMETER CHARACTERISTICS OF MACHINE FOR EXTRACTION OF SEEDS FROM VEGETABLE CROPS

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Summary. The results of the experimental research of the machine for the selection of seeds of vegetable crops. As a result of the received diagrams of the dependence of losses and impurity of seeds certain basic parameter descriptions have the following indexes: the angle of slope of the whip plate to the axis of whip is from 31° to 36°, the gap between the whip and the sieve is from 10 to 19 mm, the speed of rotation of the whip is 3.5 to 4.2 m/s and the size of supplying the seeds for processing is 0.5 to 1.1 kg/s.

Key words: losses of seed, impurity of seed, supplying the seed, whip mechanism

INTRODUCTION

The production of the seeds of vegetable-water-melon crops in the South of Ukraine at the beginning of the 90s of the last century almost fully disappeared as industry. Therefore, the problem of obtaining the seeds of vegetable crops in the mechanized way is one of the important problems, facing the industry of processing the agricultural products. The problem of obtaining the seeds of sweet pepper and capsicum needs its solution at present. The absence of the sufficient amount of the domestic seed material at the Ukrainian market testifies this [Dumenko 2002].

A majority of the equipment which remained on the specialized farms in the South of Ukraine is morally and physically out-of-date now [Melnikom *et al.* 1980, Dumenko 2002]. Besides, among the machines created earlier there are no machines that were intended for obtaining the seeds of pepper. The adopted machines which are used for the production of seeds of other vegetable crops (tomatoes, egg-plants, water-melons) do not allow to obtain the seeds of high quality. As a rule, such machines include a grinder of fruit, a separator, a seed washing machine and a drying aggregate. The list of such components provides for the complete grinding of fruit, as a result of which most of the obtained seeds of pepper do not meet the agro-technical requirements, as plenty of particles equal to the size of seeds appear. Impurity and losses of seeds greatly exceed the norma-

tive indexes. Besides, these machines account for a high level of production expenses such as water, electric energy and human labor while producing the seeds of sweet pepper and capsicum.

Summing up, we can come to the conclusion that it is necessary to continue the research in the field of: mechanizing the process of obtaining the seeds of vegetable and melon crops (watermelons, melons and gourds); working out the theoretical and practical grounds of the process; designing a machine with a proper form of the working chamber and the principle of the operation of the working parts, as the structure of pepper fruit is different from that of other vegetables of Solanaceae family (tomatoes, eggplants, etc); the main objective being cutting the production costs of the seeds material and saving the energy.

MATERIALS AND METHODS

The features of the pepper fruit make it possible to disconnect a small food box from the peduncle with the seeds with the purpose of obtaining the seeds, which considerably simplifies the problem set. Therefore, there is no necessity to grind down fully all the fruit for the destruction of the connections which retain the seed in the seminiferous vegetable.

Giving up grinding the fruit, we eliminate the necessity to use water for the subsequent revision of seed, as the shell will be absent in the treated mass, as well as plenty of small admixture.

The problem research laboratory for developing energy effective agricultural machinery and technologies at Mykolaiv State Agrarian University created a new machine for providing mechanized technology of obtaining the seeds of sweet pepper and capsicum, which is a grinder of vegetable fruit. The machine has the planetary type of working organs which dissociate the seeds from a peduncle by the shock interaction [Dumenko 2002, Pastushenko and Dumenko 2005a]. The seeds are knocked out of the seminiferous part, thus substantially decreasing the amount of admixture in the treated mass which goes to the further separation. The invention is patented in Ukraine [Pastushenko *et al.* 2005b].

Taking into account that the technological process of obtaining the seeds with the developed machine does not need the use of water, the possibility of including the dielectric separator for the further revision of seeds appears, the application of which allows to separate easily the admixtures which remained in it and also to promote the energy of the field growth.

The use of such machine allows to provide the separation of seeds from the wiped mass, reduces seeds damage and allows to process fruit with seeds of different hardness.

RESULTS AND DISCUSSION

During 2002–2004 the laboratory tests of the machine were conducted, with the purpose of obtaining the experimental information about its efficiency. The tests were carried out on the basis of the theory of experiments planning [Melnikov *et al.* 1980]. After deleting the less important factors and ranging the factors which had greater valid-

ity, the four factor three leveled plan of Box of the second order was chosen for conducting the experiment [Pastushenko *et al.* 2005b].

In accordance with the plan the experiment of the estimation of the dependence of indexes on the quality of the implementation of a technological process which most influence the quality of the machine operation was conducted, among which there are: the angle of slope of the whip plate to the axis of the whip (XI), the gap between the whip and the sieve (X2), the speed of rotation of the whip (X3), and the size of supplying the seeds for processing (X4).

The statistical processing of the received data was carried out in the laboratory, with the construction of the volume diagrams of the dependence of indexes on the implementation of the technological process on the losses and impurity of seeds (Fig. 1–4).

The volume diagrams unlike the flat surfaces of the review enable not only to define the areas of the optimum combination of factors and criteria of the optimization but also the character of distributing the losses (LS) and impurity (IS) of seeds in all the area of conducting the experiment.



Fig. 1. Diagram of the LS and IS dependence on the size of supplying the seeds for processing and the angle of slope of the whip plate to the axis of whip



Diagram of dependence of losses and impurity of seeds on the size of supplying the seeds for processing and the angle of slope of the whip plate to the axis of a whip (Fig. 1) allows to say that at this combination of factors the most optimum value of the serving size while supplying the seeds for processing is within the limits of 0.5 to 1.1 kg/s, and the slope angle of the whip plate to the axis of whip is -31° to 39° . Thus, such optimum areas are represented on a diagram by the darkest colour when both surfaces of distributing the losses and impurity of seeds are below the level of the plane of the agrotechnical requirements of 5%.



Fig. 2. Diagram of the LS and IS dependence on the speed of rotation of the whip and the angle of slope of the whip plate to the axis of the whip



Fig. 3. Diagram of the LS and IS dependence on the speed of rotation of the whip and the gap between the whip and the sieve

On the diagram of dependence of losses and impurity of seeds on the speed of rotation of the whip and the angle of slope of the whip plate to the axis of whip (Fig. 2) the optimum area (the darkest colouring) has the indexes of the speed of rotation of the whip within the limits of 3.5 to 4.2 m/s and the angle of slope of the whip plate to the axis of whip from 15° to 36° .

The analysis of the diagram of dependence of losses and impurity of seeds on the speed of rotation of the whip and the gap between the whip and the sieve (Fig. 3) showed that the optimum combination of factors, which is represented by the dark plane, has the following sizes: the speed of rotation of the whip is from 3.5 to 4.7 m/s; the gap between the whip and the sieve from 10 to 20 mm.



Fig. 4. Diagram of the LS and IS dependence on the size of supplying the seeds for processing and the gap between the whip and the sieve

The diagram of the dependence of losses and impurity of seeds on the size of supplying the seeds for processing and the gap between the whip and the sieve (Fig. 4) enables to say that at this combination of factors the most optimum value of the size of supplying the seeds for processing is within the limits is 0.5 to 1.4 kg/s, and the gap between the whip and the sieve is from 10 to 19 mm.

CONCLUSION

As a result of the analysis of the diagrams and conducted research it is possible to make a conclusion about the optimum parameter features of the machine for obtaining the seeds of the vegetable crops which have the following indexes: the angle of slope of the whip plate to the axis of whip is from 31° to 36° , the gap between the whip and the sieve is from 10 to 19 mm, the speed of rotation of the whip is from 3.5 to 4.2 m/s, and the size of supplying the seeds for processing is within the limits is 0.5 to 1.1 kg/s.

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