The Application of agglomerative granulation for seeds. Part 2. Pelleting of organic seeds

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Introduction

Pelleting of vegetable plant seeds is based on expanding a seed size with a method of non-pressure agglomerative granulation by applying bulking material in a powder form. The inside of pellet may contain layers with ecological agents for seed protection, mineral salts, microelements, microorganisms and other auxiliary substances. The granulation process allows them to be applied precisely. The location of added substances depends on their function. Covering the additives with an outer layer acts as a barrier against soil pathogens, provides the mechanical durability and improves ballistic properties of seeds. The agro-technical effects are as follows: the top-quality seed material with improved germination ability and compensated field seedlings of plants eliminating the time-consuming weeding and plant thinning. Pelleting and precise seed sowing provides the uniform cover of plantations with plants, which affects the crop quality. Due to these advantages, ecological farms have expressed their interest in pelleted seeds.

Objective of work

The objective of this work was to select the composition of seed pelleting materials on the basis of raw materials recommended in the system of ecological crops and to test the impact of various methods of preparing seeds for sowing on the quality of pelleted seeds.

Materials and methodology

The applied materials for pelleting organic seeds should meet the following requirements: they have to be of natural origin and cannot be chemically treated, they should contain substances for plant growth.

The following materials were selected for the tests: ground dolomite, kaolin and peat, wood dust from timber of broad-leaved trees, and talc. Aqueous solution of yellow dextrin was used as granulation liquid. The above materials meet the ecological requirements.

The maximum particle-size distribution of powders used for pelleting are as follows: ca. 90 μm for wood dust, ca. 20 μm for dolomite, ca. 15 μm for kaolin, ca. 50 μm for peat, and ca. 15 μm for talc. The particle-size distribution of powders used for granulation was measured with a laser particle size analyser Analysette 22 of Fritsch company. 5% aqueous solution of yellow dextrin was used as granulation solution.

Apparatus

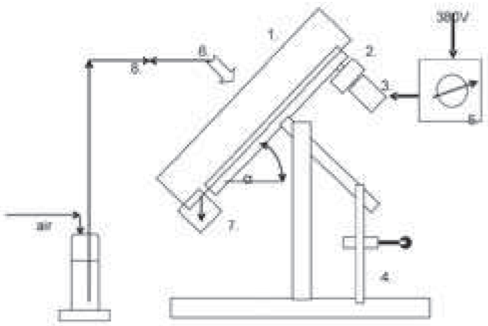

Fig.1 Diagram of a test stand for plate granulation
1 – granulating plate, 2 – plate bottom, 3 – engine with transmission, 4 – screw elevator, 5 – inverter, 6 – pressure atomiser, 7 – protractor, 8 – control valve for granulation liquid

The plate granulator with an adjustable inclination angle of plate axe and granulation plate with a diameter of 0.6 m was used for pelleting vegetable seeds. The screw elevator (4) was used to adjust the angle of plate inclination. The drive consisted in a three-phase motor with power of 0.36 kW controlled by the inverter enabling the smooth adjustment of plate rotations. Hydraulic pressure atomiser was used to feed the granulation liquid providing the proper atomisation of dosed granulation liquid.

Selection of wood dust content for seed pelleting

The tests on germination ability of produced pelleted seeds were carried out to find a range for optimum content of wood dust. Quickly germinating seeds of radish were used in the tests.

Methodology

Various amounts of wood dust within a range of 0% - 90% per kaolin and dolomite mass were added to the pelleting material containing 40% of kaolin and 60% of dolomite. The radish seeds were granulated using 5% aqueous solutions of dextrin for pelleting. Dried seeds were germinated in boxes with accordion-pleated oil filter paper at various levels of its saturation with water, in accordance with the methodology described by Domoradzki [1999].

The test results for germination ability of different contents of wood dust and different levels of substrate saturation with water are presented in Figure 2. The germination ability of pelleted seeds was found to depend on a saturation level of germination substrate with water.

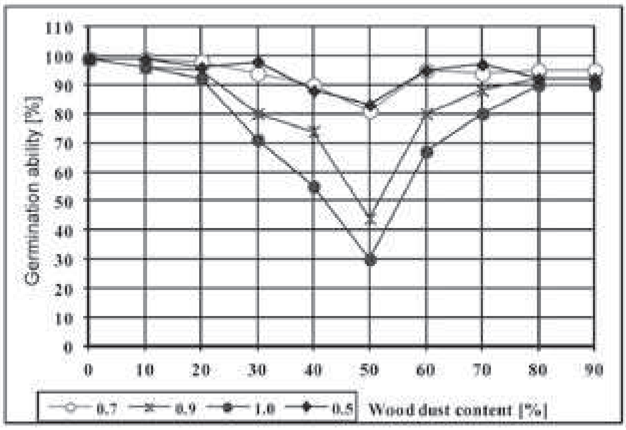

Fig. 2. Dependence of radish seeds germination on wood dust content in a pellet at different levels of germination substrate saturation with water

According to Figure 2, the highest germination abilities were observed for wood dust content in the ranges of 0% to 20% and 80% to 90%. They are the most favourable ranges for seed pelleting.

Taking into account the relationship illustrated in Figures 2 and 3, high dust content and low water absorption foster the germination abilities. Such a situation occurred for wood dust content in a pelleting mixture in a range from 0% to 20%. The slightest changes in germination abilities were observed for the level of substrate saturation with water below 0.7.

For subsequent tests, seeds were pelleted with a mixture of 40% of kaolin and 60% of dolomite, to which 20% of wood dust was added.

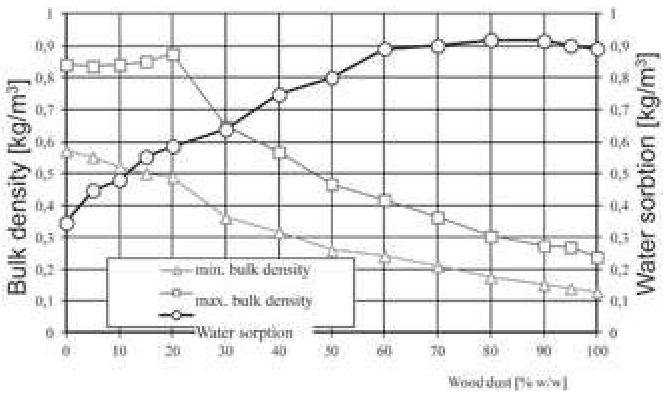

Fig. 3. Relationship between bulk density and water sorption for dolomite and kaolin mixtures with wood dust

Seed preparation for sowing on ecological plantation

Qualified elite seed intended for an ecological plantation were divided into fractions, of which a fraction with the highest germination ability was used for further treatment.

1. Perfekcja carrot fraction 1.8-2.0 mm GA 88%.
2. Ołomuńcka parsley fraction 1.2-1.4 mm GA 98%.

The non-treated seeds from a traditional plant raising were used in the tests. A few types of pelleted seeds to be sown on experimental plots in an ecological farm were prepared. A portion of seeds was washed in warm water at 20°C or subjected to heat treatment in water at 50°C. The control seeds – raw and pelleted, were additionally verified in pot experiments.

The experiments were expected to be carried out five times, each repetition included a pot with 20 seeds. Seedling emergence was observed after 10 and 20 days from sowing.

Carrot

Table 1

A number and height of carrot seedlings in a pot experiment

Combination	Time of observation 1			Time of observation 2		
	Average height [mm]	Seedlings		Average height [mm]	Seedlings	
		number	% for control		number	% for control
Control	14.4	45	100.0 a	15.3	56	100.0 a
T. viride + pellet	11.2	43	95.5 ab	12.2	52	92.9 b
Chitosan + pellet	13.3	39	86.7 b	14.8	51	91.1 b

*/ identical letters in a column denote values of slight difference (α=0.05)

At observation times, the pelleted seeds exhibited delayed emergence in comparison with control seeds, and consequently seedlings had lower average height.

Table 2

Influence of carrot seeds washing and treating with *Trichoderma viride* on germination during the pot experiment

Combination of seeds	% of germinated seeds	number of cfu on seed (in pellet)
Control	50.0 b	-
Washing	67.0 a	-
Washing + pellet	65.0 a	-
Washing, treating with *T. viride* (without a pellet)	68.0 a	173.5
Washing, treating with *T. viride* + pellet	73.0 a	46.0

* identical letters in a column denote values of slight difference (α=0.05)

The conducted experiments have demonstrated a positive impact of seed washing on germination under the conditions of the pot experiment. The combination of simultaneous washing, pelleting and inoculating with spores of fungus *Trichoderma viride* gave the best germination results (Tab.2).

The comparison of seeds inoculated with spores of fungus *Trichoderma viride* without a pellet and with a dried pellet indicated an adverse impact of drying on the survival rate of spores. Thus, it is necessary to increase a dose of formulation during inoculation and/or mitigate drying conditions.

Parsley

The effect of washing and treating parsley seeds with *Trichoderma viride* on a number of seedling emergence in the pot experiment is presented in Table 3.

Table 3

Influence of washing and treating parsley seeds with *Trichoderma viride* on a number of seedlings in the pot experiment

Combinations	Number of seedlings
Control	42
Washing + pellet	45
Washing, treating with *T. viride* (without a pellet)	43
Washing, treating with *T. viride* + pellet	42

The presented results show minimally better effects in case of seed washing.

Field tests

The tests were carried out in production fields at an ecological farm in Kiełpino. The experimental crops were cultivated in soil belonging to IIIa and IIIb quality classes. Soil pH was equal to 7.0 and 6.6 respectively. The data were obtained from tests commissioned by the Regional Chemical and Agricultural Station in Bydgoszcz.

Germination of carrot seeds in the field

Table 5

Carrot seedling emergence in the field test in comparison with the control

Combination (pellet)	Number of seedling emergence		
	average from 100 seeds	% in comparison with the control	Average weight of seedling
Control	42.2	100.0	0.18 b
Washing + pellet	42.7	101.4	0.40 a
Washing, treating with *T. viride* (without a pellet)	35.2	83.4	0.39 a
Washing, treating with *T. viride* + pellet	38.0	90.0	0.34 a
Washing, treating with *T. viride* + pellet	42.8	101.4	0.33 a

Identical letters in a column denote values of slight difference (α=0.05)

The additional tests on vigour of germinating seeds by determining an average weight of seedlings were performed for carrot seeds. The analysis of results did not reveal any significant differences in a number of seedling emergence. Average weight of seedlings from the control combination was lower. None pathological symptoms were observed on seedlings.

Germination of parsley seeds in the field

Table 4

Parsley seedling emergence in the field test in comparison with the control

Combination		% of seedlings in comparison with the control
1	Control	100.0 a
2	Heat treatment	83.8 b
3	Heat treatment + pellet	107.2 a
4	Chitosan + pellet	99.6 a
5	*Trichoderma viride* + pellet	100.9 a

Identical letters in a column denote values of slight difference (a=0.05)

None pathological symptoms were observed on germinating seeds.

Summary

The conducted experiments show that a mixture of powder containing 33% of kaolin, 50% of dolomite and 17% of wood dust is the best combination of raw materials for pelleting organic seeds.

The applied combination of three processes: washing, pelleting and inoculating with spores of fungus *Trichoderma viride* provides the best germination results.

The comparison of seeds inoculated with spores of fungus *Trichoderma viride* without a pellet and with a dried pellet indicates an adverse impact of drying on the survival rate of spores, which is related to the necessity to increase a dose of this formulation during inoculation.

Literature

1. Domoradzki, M (1999), Determination of germination capability of coated seeds. Int. Agrophysics **13**, 431-433
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