

CORE Organic Cofund



“SCOOP: Developing intercropping systems with camelina to increase the yield and quality parameters of local underutilized crops”

Deliverable report

D 3.1. Report on the optimization of post-harvest separation technologies for SCOOP mixtures

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This report focuses on the cleaning of harvested seeds from the large scale trials with camelina intercropping in Poland (Fig. 1).

Biosfera company used Petkus separation and cleaning line (Fig. 2) for seeds collected from:

- spring camelina, grown as a sole crop,
- spelt wheat (spring form), grown as a sole crop,
- and the separation of spelt wheat and camelina seeds from intercropping system.

The cleaning tests were performed in 2023 and 2024. The collected seeds contained the following impurities:



Fig. 1. Seeds before cleaning: a) camelina grown as a sole crop, b) spelt wheat grown as a sole crop, and c) spelt wheat and camelina seeds from intercropping system

The following set was used for separation and cleaning (Fig. 2):

- Petkus K-523 pre-cleaning machine;
- Petkus U15 universal cleaner;
- Petkus ZA 931 intended cylinders (trieurs) set;
- Petkus G40 gravity table;



Fig. 2. Cleaning and separation line used in SCOOP project for cleaning and separation of camelina and companion crop seeds

In the case of separation of intercropped spelt wheat grain and camelina seeds, the following setting was used:

1. Petkus K-523 pre-cleaning machine - used to pre-clean and reject large weeds and biological parts such as:

- Upper screen: straw, stones, clods of earth, sticks.
- Bottom screen: dust, sand particles and crushed grains.
- 1st and 2nd air chambers: light elements: straw, dry plant elements, dust.

Then the seeds went to a universal cleaner.

2. Petkus U15 universal cleaner - it was used to clean the seeds in terms of shape, some of the impurities, including weeds such as:

- Upper screen: large spelt grains.
- Bottom screen: camelina (separation) and weeds: goosefoot (*Chenopodium album*), pale persicaria (*Polygonum lapathiofolium*), black-bindweed (*Fallopia convullus*), cleavers (*Galium aparine*).
- air chambers: cornflower (*Centaurea cijkanus*), couch grass (*Elymus repens*), empty and light spelt grains, dust.

The seeds were then placed on a intended cylinders set.

3. Petkus ZA 931 intended cylinders set - was used to separate seeds according to shape. Here, the unhulled spelt grain was separated from the halves, as well as the weeds on the upper drum: field pennycress (*Thlaspi arvense*).

The seeds were then placed on the gravity table.

4. Petkus G40 gravity table - Empty spelt grains and light weed seeds such as shepherd's purse (*Capsella bursa-pastoris*).

The above allowed to separate spelt grain from intercropped camelina. Then, cleaning was carried out separately for camelina and spelt using the methods described below also for plants grown solely.

In the case of cleaning spring spelt wheat grain from sole cultivation, the following setting was used::

1. Petkus K-523 pre-cleaning machine - used for preliminary cleaning and rejection of large weeds and biological parts such as straw, awns, etc.

- Bottom screen: sand and dust, weed seeds: goosefoot (*Chenopodium album*), pale persicaria (*Polygonum lapathiofolium*), black-bindweed (*Fallopia convullus*).
- 1st and 2nd air chamber: dust, weed seeds: figleaf goosefoot (*Chenopodium ficifolium*).

Then the seeds went to a universal cleaner.

2. Petkus U15 universal cleaner - was used to clean the grain for shape; here the rest of the weeds were removed.

- Upper screen: large elements - pebbles similar in size to spelled grains, sticks and straws below the size of the opening of the upper screen.
- Bottom screen: small spelt grains, broken grain elements, weeds: goosefoot (*Chenopodium album*).
- 1st and 2nd air chamber: dust, light spelt grains, weeds: couch grass (*Elymus repens*).

The seeds were then placed on a intended cylinders set.

3. Petkus ZA 931 intended cylinders set - used to separate seeds according to shape, here the hulled spelled grains were cleaned - halves.

The seeds were then placed on the gravity table.

4. Petkus G40 gravity table – empty, non-emerging spelt grains.

In the case of cleaning camelina seeds from sole cultivation, the following setting was used:

1. Petkus K-523 pre-cleaning machine - used to pre-clean and reject large weeds and biological parts such as straw and dust:

- Upper screen: pebbles, sticks, weeds: pale persicaria (*Polygonum lapathiofolium*), black-bindweed (*Fallopia convullus*).
- 1st and 2nd air chamber: dust, light camelina seeds.
- Lower screen: dust, sand.

Then the seeds went to a universal cleaner.

2. Petkus U15 universal cleaner was used to separate the seeds for shape, here the rest of the weeds were removed.

- Upper screen: self-sown cereals, cornflower (*Centaurea cijkanus*)
- Bottom screen: fine camelina seeds.
- 1st and 2nd air chamber: light elements, dust, weed seeds: cornflower (*Centaurea cijkanus*).

The seeds were then placed on a intended cylinders set.

3. Petkus ZA 931 intended cylinders set was used to separate seeds according to shape. Camelina seeds were cleaned here, lower drum: shepherd's purse (*Capsella bursa-pastoris*).

The seeds were then placed on the gravity table.

4. Petkus G40 gravity table - light, non-emerging seeds of camelina, remaining seeds of common shepherd's purse (*Capsella bursa-pastoris*).

The settings of the machines for cleaning and separating camelina and spelt what are presented in Table 1.

Table 1. Cleaning protocol and equipment settings

Equipment	Spring spelt what + spring camelina SEPARATION	Spring spelt what	spring camelina
Petkus K-523 pre-cleaning machine	(upper deck) round hole screen 9,00 mm (bottom deck) slotted screen 0,50 mm	(upper deck) round hole screen 12,00 mm (bottom deck) slotted screen 1,80 mm	(upper deck) round hole screen 1,80mm (bottom deck) slotted screen 0,70 mm
Petkus U15 universal cleaner	(upper deck) slotted screen 4,25 mm (bottom deck) slotted screen 1,20 mm	(upper deck) slotted screen 3,75 mm (bottom deck) slotted screen 2,20 mm	(upper deck) round hole screen 1,50 mm (bottom deck) slotted screen 0,50 mm
Petkus ZA 931 intended cylinders (trieurs) set	3,60 mm – upper drum, bottom drum - no cleaning	5,6 mm - upper drum 8,0 mm - bottom drum	2,2 mm - upper drum 3,6 mm - bottom drum

Petkus G40 gravity table	tilt along 1,2° tilt aside 3,2° airflow 45%, 48%, 51% vibrations – 2nd step	tilt along 1,4 ° tilt aside 3,8 ° airflow 50%, 52% 55%, vibrations – 4th step	none
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The electricity consumption per 1 ton of obtained camelina seeds from sole cropping was 25.3 kWh/t (table 2). For spelt from sole cropping it was half as much (12.6 kWh/t). On the other hand, the energy needed for cleaning and separating spelt and camelina from intercropping was a total of 33 kWh/t. Cleaned camelina seeds from sole sowing were characterized by a purity of 96.2%. The remaining 1.0% were other seeds, and 2.80% other impurities. On the other hand, seeds from intercropping were characterized by a purity of 95.3%, the remaining 1.4% were other seeds, and 3.3% other impurities.

Table 2. Electricity use for seed cleaning

Cropping system	Efficiency [t/h]	Input [kg]	Working time [h]	Mean energy use per 1h of cleaning [kW]	Energy consumption [kWh]	Energy consumption [kWh/tonne]
Spelt sole cropping	1.2	275	0.23	15.16	3.474	12.6
Camelina sole cropping	0.6	120	0.20	15.16	3.032	25.3
Camelina and spelt from intercropping	0.8	450	0.56	15.16	8.528	18.9
Spelt after separation	1.4	305	0.22	15.16	3.303	7.58
Camelina after separation	0.5	110	0.22	15.16	3.335	6.52

Additional Energy consumption

Machine pre-start	1.6 kWh
Cleaning after working day	10 kWh