

Sowing qualities of pea seeds

Author(s): гл. ас. д-р Евгения Жекова, Институт по земеделие и семезнание "Образцов чифлик" - Русе,
Селскостопанска академия

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Summary

High-quality seed material is of decisive importance for the quantity and quality of the obtained plant production. The mass production of pea seeds is significantly affected by abiotic (meteorological conditions) and biotic (attacks by diseases, pests and weeds) environmental factors, with one of the most dangerous pests being the pea weevil.

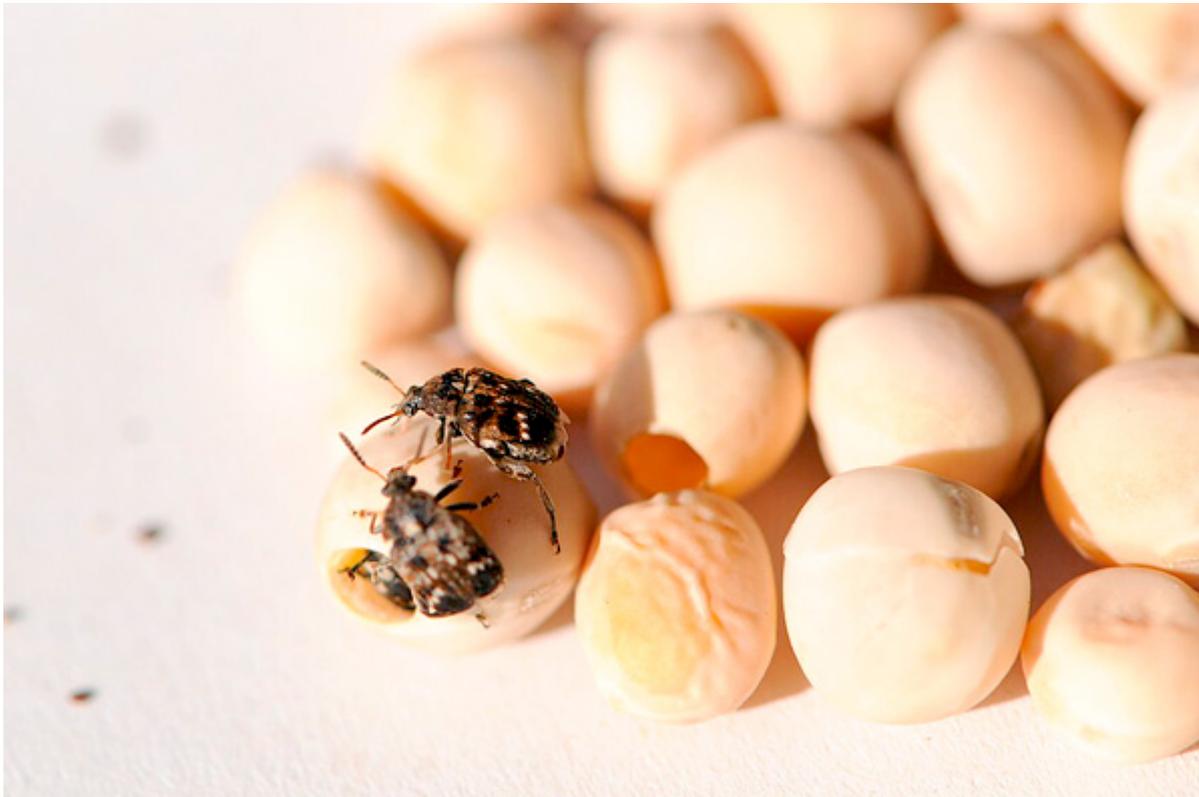
During the period 2018-2021 at the Institute of Agriculture and Seed Science "Obraztsov chiflik" – Ruse, the condition of the seeds of spring forage pea cultivar "Ruse 1", which were used for sowing, was studied in order to determine its economic value and the seeding rate. It was established that as a result of the damage caused

by the larvae of the pea weevil, the pea seeds lose part of their mass (up to 12.3%) and germination capacity (up to 64%). The lower germination of the spring forage pea seeds deteriorates the economic (sowing) value of the seeds. The low economic value of the seeds, in combination with the lower thousand seed weight, leads to large differences in the crop seeding rate over the years (from 13.563 to 29.902 kg/da).



Cleaning, sorting and selection of the seed material are the main activities through which the agrotechnical method for control of harmful insects is implemented (Kharizanov and Kharizanova, 2018). These activities are of particular importance for the control of seed beetles and in particular of the pea weevil (*Bruchus pisorum* L.) – one of the most dangerous pests of the seeds of field forage pea in the world and in Bulgaria (Ilieva and Dochkova, 2000; Mendesil et al., 2016). Globally, infestation levels of pea seeds vary from 10 to 90%. As a result of their vital activity, seed beetles damage the seeds, which is expressed in weight loss, reduced germination, deterioration of nutritional qualities and economic losses due to the reduced market value of the seeds. Burns and Briggs (2001) report damage to pea seeds ranging from 42 to 82% in the United States, and Baker (1998) – 15-20% in South Australia, with infested seeds losing up to 25% of their weight as a result of larval feeding. In Bulgaria, Ilieva and Dochkova (2000) indicate that the degree of damage caused by pea weevil to seeds of spring forage pea is high and in some cultivars reaches 46.5%. At the same time, damaged seeds lose 21.3-32.4% of their weight and 84-100% of their germination capacity (Dochkova and Naneva, 1995). In addition, damaged seeds are prone to fragmentation during harvesting and germination, the health status of the

seedlings is seriously affected, and due to the presence of *cantharidin* (in the insect body and its excrements) they are dangerous for consumption by humans and animals (Lecheva, 1989).



Early-flowering cultivars of winter and spring forage pea are more heavily attacked by pea weevil compared to medium-early and late-flowering cultivars, due to the coincidence of the mass flight of the weevil with the mass flowering of the pea and the formation of the first green pods (Dochkova et al., 1990). Spring forage pea cultivars do not contain condensed tannins in the seed coat, which is a prerequisite for a higher degree of damage to the seeds compared to wintering cultivars (Ilieva and Dochkova, 1999).

According to FAO data, in the period 2018-2021, in Bulgaria the areas under peas have halved, the yield fluctuates with a decreasing trend, as a result of which the total quantity of grain production decreases (Table 1).

Таблица 1. Данни за производството на грах в България

Показател	2018	2019	2020	2021
Площ, ha	30780	15860	14320	15430
Добив, kg ha ⁻¹	1791.7	2525.2	2068.4	1820.5
Продукция, t	55150	40050	29620	28090

The aim of the present study is to determine the condition of the seeds of spring forage pea cultivar “Ruse 1”, which will be used for sowing, with a view to determining their economic value and the seeding rate.

Material and methods

The study was conducted during the period 2018-2021 in the experimental field of the Institute of Agriculture and Seed Science “Obraztsov chiflik” – Ruse. The field forage pea “Ruse 1” was bred at the Institute of Agriculture and Seed Science “Obraztsov chiflik” – Ruse. Its vegetation period is 72-91 days and it belongs to the group of medium-early maturing pea cultivars. The pods are multi-seeded (4-7 seeds) with a smooth surface. The seeds are spherical in shape, the seed coat is yellow. The average number of seeds per plant is 50. Thousand grain weight – 283.9 g. Crude protein content in the grain – 23.15%. The good drought tolerance and high adaptability of the cultivar allow it to be grown in all regions of the country (Patenova et al., 2007).

The pea crops were grown using conventional technology, which includes two insecticide treatments (at the beginning and at the end of flowering) with a product registered for control of pea weevil (Decis 2.5 EC).

During the preparation for sowing, bulk samples (about 500 g) of seeds were taken in three replications and the following indicators were recorded:

- thousand seed weight – by weight, according to the Methodology for sampling and analyses for purity, germination and thousand grain weight, 2009
- damaged seeds – number in a sample of 100 seeds, visual assessment
- weight loss as a result of the vital activity of the pea weevil larva, in percent – according to the formula of Adams and Schuller (1978)
- germination – in percent, according to the Methodology for sampling and analyses for purity, germination and thousand grain weight, 2009

The economic value of the seeds was calculated by the formula:

$$CC = \frac{A \times B}{100}$$

where

EV – economic (sowing) value

A – seed purity, %

B – seed germination, %

and is used for determining the seeding rate, kg/da

$$CH = \frac{D \times E}{CC \times 10}$$

where

SR – seeding rate

D – thousand seed weight, g

E – number of plants per 1 m²

EV – economic value (Trankov et al., 1993)

The differences between the variants were tested using one-way analysis of variance (ANOVA). The statistical evaluation of the data was performed with the Statgraph software (P ≤ 0.05).

Results and discussion

Thousand seed weight is the main component of yield and is used as a measure of seed size, which can vary depending on many factors, including meteorological conditions (AGRI-FACTS, 2018). Over the four years under study, the recorded thousand seed weight varied from 147.7 to 272.0 g and is lower compared to the data presented by the breeders of the cultivar (Table 2). This is explained by the unstable agrometeorological conditions of the region, which have had an adverse effect on the spring forage pea crops in recent years (Gintchev and Zhekova, 2021). Water stress and extreme temperatures are limiting factors. Water deficit also affects the ability to fix atmospheric nitrogen (Benezit et al., 2017).

Таблица 2. Маса на 1000 семена и кълняемост на семена грах

Година	Маса на 1000 семена, g	Кълняемост, %	Стопанска стойност	Сеитбена норма, kg/da
2018	252.5 ^c	96.5 ^d	95.53	21.145
2019	272.0 ^c	73.5 ^b	72.77	29.902
2020	147.7 ^a	88.0 ^c	87.12	13.563
2021	201.3 ^b	64.0 ^a	63.36	25.417

Legend: Values followed by different letters in each column are significantly different at P ≤ 0.05.

The damaged seeds, as a result of the vital activity of the pea weevil larvae and the emergence of adults of the new generation, are presented in Table 3.

Таблица 3. Повредени семена и загуба на маса

Година	Проба, бр. семена	Здрави семена			Повредени семена			Загуба на маса, %
		брой	тегло, g	%	брой	тегло, g	%	
2018	100	85 ^b	16.76 ^c	85	15 ^a	2.40 ^a	15	3.4 ^a
2019	100	80 ^b	15.49 ^c	80	20 ^a	3.30 ^a	20	3.3 ^a
2020	100	61 ^a	11.31 ^b	61	39 ^b	5.97 ^b	39	5.6 ^{ab}
2021	100	47 ^a	7.68 ^a	47	53 ^b	6.74 ^b	53	12.3 ^b

Legend: Values followed by different letters in each column are significantly different at $P \leq 0.05$.

The damaged seeds vary from 15 to 53%, with a noticeable increasing trend over the years studied. The two insecticide treatments with Decis 2.5 EC proved to be an ineffective method for controlling pea weevil, probably due to resistance of the species and/or shortcomings in its application. With an increase in the proportion of damaged grains, the healthy ones logically decrease – from 85 to 47%. As a result of the increase in the percentage of damaged seeds, the weight loss in the seed material also increases (Table 3). The calculated weight loss reached its highest level in the last year of the study – 12.3%.

The increase in the percentage of damaged seeds has a direct effect on seed germination, which for the study period decreased from 96.5 to 64% (Table 2). Such a decline in germination, due to the large number of damaged seeds, is consistent with the findings of other researchers and is explained by the fact that during its development in the seed, the pea weevil larva feeds by destroying the embryo and a large part of the endosperm, as a result of which the seeds do not germinate or germination is reduced (Nikolova and Georgieva, 2015; Nikolova, 2022).

Conclusions

As a result of the damage caused by the larvae of the pea weevil, pea seeds lose part of their mass (quantitative damage) and germination capacity (qualitative damage).

As a result of the lower germination of spring forage pea seeds, the economic (sowing) value of the seeds deteriorates (decreases).

The low economic value of the seeds, in combination with the lower thousand seed weight, leads to large differences in the crop seeding rate over the years.

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