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VARIABILITY OF THE NUMBER AND WEIGHT OF 1000 SEEDS OF WEEDS PRESENT IN ALFALFA NATURAL SEEDS FROM DIFFERENT LOCATIONS IN SERBIA

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INTRODUCTION

Alfalfa is characterized by high seed yield variability (Ahmad et al 2020; Bolaños-Aguilar et al. 2002) and in Serbia (Pajcin et. al., 2020; Stanisavljević et. al., 2012). Weeds in the alfalfa seed crop also contribute to this (Janjić et al., 2005), with the most dangerous quarantine weed – field dodder (*Cuscuta* sp.), (Sarić-Krsmanović et. al., 2020). An important contribution to the economy of alfalfa seed production is efficient seed processing that will allow as little seed loss as possible (Đokić et. al., 2021). For the purpose of such processing, for each lot of seeds, it is necessary to analyze natural alfalfa seeds for the presence of weed seeds and other impurities and based on their number and size, the shape of the seed pod, etc. choose the appropriate finishing system, and the correct setting of the machines (Đokić et. al., 2023). During the seed processing, natural seeds pass through a system of machines that separate impurities such as dry stalks, weeds and broken seeds (Uhlarek et. al., 2018). The aim of these tests was to determine which weeds were present, what their mass per 1000 seeds was and how many of them were present in the sample, from five localities – seed lots of natural seeds - during three years.

MATERIAL AND METHOD

For testing, natural alfalfa seeds were taken from five localities – seed lots, namely the surroundings: I) Zrenjanin, II) Novo Miloševo, III) Negotin, IV) Banatsko Karađorđevo, V) Srpska Crnja. In all localities, seed production was from the second mowing.

Alfalfa crops were established in 2019, so seed was sampled from the first, the second, and the third year of seed production.

During all years, from all seed lots, 4 (repetitions) x 50 g weight of the average sample were taken and weed seeds were separated, the number and weight of 1000 seeds were determined, in accordance with the regulation on seed quality ("Official Gazette of SFRY, 1987; 47 /87; and Annex, 34/2013) which is harmonized with ISTA rules (ISTA, 2021).

For all tested traits the variability was determined through the coefficient of variation (CV %) for each seed lot over three years. For the statistical analyses, a statistical program Minitab Inc., version 16.1.0, free version was used.

DISCUSSION

As expected, a high variability was found for the number of weed seeds: in 2020 from CV% = 34.64 (red sorrel - *Rumex acetosella* L.) to CV% = 65.47 (ribwort plantain - *Plantago lanceolata* L.); in 2021 from CV% = 33.32 (red sorrel - *Rumex acetosella* L.) to CV% = 48.58 (wild sorghum - *Sorghum halepense* L. Pers.); in 2022 from CV% = 14.78 (wild sorghum - *Sorghum halepense* L. Pers.) to CV% =60.93 (curly dock - *Rumex crispus* L.). There is an evident increase in the number of weed seeds in the tests conducted on the seeds from 2022, the lowest number of weed seeds was in the alfalfa seed crop from 2021, and the lowest from the 2020 sample. During the examination of samples from five locations-lots from 2020, weed seeds were detected and variability was determined for the mass of 1000 seeds: from CV% = 5.869 ribwort plantain - *Plantago lanceolata* L. to CV% = 13.40 (wild sorghum - *Sorghum halepense* L. Pers.) Weeds from the genus *Cuscuta* spp. is the most difficult to control because it lives on many plants (Sarić-Krsmanović et. al., 2022), and is especially dangerous in alfalfa (Sarić-Krsmanović, et. al., 2020, 2015). In addition, seeds in the soil can be dormant for dozens of years, and are transmitted by domestic and wild animals. If the seed of the dodder (*Cuscuta* sp.) is present in the unprocessed-natural alfalfa seed, it is very difficult to remove it, considering that it is similar to the alfalfa seed in size and shape. For these reasons, processing alfalfa seeds has very high costs for removing weed seeds, especially quarantine weeds (Đokić et. al., 2021, 2023).

Natural alfalfa seeds		Weed seeds in 50 g of natural alfalfa seeds		
Variety	The origin of natural seeds	Common and Latin name of the weed	Number of weed seeds	1000 seeds weight (g)
Banat	Zrenjanin	Curly dock - Rumex crispus L.	3	1.513
		Red sorrel - Rumex acetosella L.	2	0.356
		Ribwort plantain - Plantago lanceolata L.	2	2.178
		Broadleaf plantain - Plantago major L.	2	4.742
Banat	Novo Miloševo	Wild sorghum - Sorghum halepense (L.) Pers.	4	3.432
		Ribwort plantain - Plantago lanceolata L.	1	1.956
		Red sorrel - Rumex acetosella L.	1	0.418
		Charlock mustard - Sinapis arvensis L.	2	1.098
Zaječarska 83	Negotin	Field bindweed - Convolvus arvensis L.	3	7.165
		Wild sorghum - Sorghum halepense (L.) Pers.	7	2.989
		Charlock mustard - Sinapis arvensis L.	4	1.212
		Curly dock - Rumex crispus L.	6	1.325
Banat	Banatsko Karađorđevo	CocksPUR grass - Panicum crus-galli L.	6	1.396
		Field bindweed - Convolvus arvensis L.	3	7.145
		Wild sorghum - Sorghum halepense (L.) Pers.	7	2.978
		Charlock mustard - Sinapis arvensis L.	4	1.278
Kruševačka 28	Srpska Crnja	CocksPUR grass - Panicum crus-galli L.	6	1.336
		Wild sorghum - Sorghum halepense (L.) Pers.	2	3.919
		Ribwort plantain - Plantago lanceolata L.	4	1.989
		Red sorrel - Rumex acetosella L.	2	0.345
Variability expressed through the coefficient of variation (CV%) for the number of seeds and the mass of 1000 weed seeds		Curly dock - Rumex crispus L.	5	1.611
		Curly dock - Rumex crispus L.	45.83	9.801
		Red sorrel -Rumex acetosella L.	34.64	10.55
		Ribwort plantain - Plantago lanceolata L.	65.47	5.869
		Wild sorghum - Sorghum halepense (L.) Pers.	48.99	13.40

Table 1. Number and weight of 1000 weed seeds in batches of natural alfalfa seeds in 2020

Natural alfalfa seeds		Weed seeds in 50 g of natural alfalfa seeds		
Variety	The origin of natural seeds	Common and Latin name of the weed	Number of weed seeds	1000 seeds weight (g)
Banat	Zrenjanin	Curly dock - Rumex crispus L.	6	1.398
		Field dodder - Cuscuta campestris Yunk.	4	1.345
		Wild sorghum - Sorghum halepense (L.) Pers.	8	4.121
		Ribwort plantain - Plantago lanceolata L.	5	2.074
		Broadleaf plantain - Plantago major L.	1	5.112
Banat	Novo Miloševo	Cleavers - Gallium aparine L.	2	3.245
		Charlock mustard - Sinapis arvensis L.	2	1.098
		Red sorrel - Rumex acetosella L.	3	0.389
		Wild sorghum - Sorghum halepense (L.) Pers.	4	3.189
Zaječarska 83	Negotin	Field dodder - Cuscuta campestris Yunk	8	1.178
		Red sorrel - Rumex acetosella L.	2	0.298
		Wild sorghum - Sorghum halepense (L.) Pers.	3	2.475
		Redroot pigweed - Amaranthus retroflexus L.	3	0.495
		Charlock mustard - Sinapis arvensis L.	2	1.321
Banat	Banatsko Karađorđevo	Ribwort plantain -Plantago lanceolata L.	3	1.702
		Redroot pigweed -Amaranthus retroflexus L.	3	0.478
		Field bindweed - Convolvus arvensis L.	4	6.089
		Wild sorghum -Sorghum halepense (L) Pers.	10	3.747
		Curly dock - Rumex crispus L.	3	1.658
Kruševačka 28	Srpska Crnja	Charlock mustard - Sinapis arvensis L.	2	1.009
		Wild sorghum -Sorghum halepense (L.) Pers.	5	3.978
		Field dodder - Cuscuta campestris Yunk	9	1.314
		Ribwort plantain -Plantago lanceolata L.	7	1.956
		Charlock mustard - Sinapis arvensis L.	4	1.223
		Red sorrel - Rumex acetosella L.	4	0.382
		Curly dock - Rumex crispus L.	9	1.458
		Curly dock - Rumex crispus L.	35.25	9.052
Variability expressed through the coefficient of variation (CV%) for the number of seeds and the mass of 1000 weed seeds		Red sorrel - Rumex acetosella L.	33.32	14.21
		Ribwort plantain -Plantago lanceolata L.	40.01	9.952
		Wild sorghum -Sorghum halepense (L.) Pers.	48.58	19.27

Table 2. Number and weight of 1000 weed seeds in lots of natural alfalfa seeds in 2021

Natural alfalfa seeds		Weed seeds in 50 g of natural alfalfa seeds		
Variety	The origin of natural seeds	Common and Latin name of the weed	Number of weed seeds	1000 seeds weight (g)
Banat	Zrenjanin	Charlock mustard - Sinapis arvensis L.	8	0.915
		Redroot pigweed - Amaranthus retroflexus L.	6	0.278
		Bitter dock - Rumex obtusifolius L.	12	1.145
		Field dodder - Cuscuta campestris Yunk.	11	1.332
		Red sorrel - Rumex acetosella L.	7	0.259
		Ribwort plantain - Plantago lanceolata L.	5	2.398
		Broadleaf plantain - Plantago major L.	14	5.156
		Curly dock - Rumex crispus L.	2	1.256
Banat	Novo Miloševo	Cleavers - Galium aparine L.	2	3.232
		Field bindweed - Convolvus arvensis L.	7	6.089
		Charlock mustard - Sinapis arvensis L.	11	1.099
		Red sorrel - Rumex acetosella L.	13	0.315
		Divlji sirak -Sorghum halepense (L.) Pers.	9	3.178
		Field dodder - Cuscuta campestris Yunk.	6	1.199
		Field bindweed - Convolvus arvensis L.	9	6.012
		Ribwort plantain -Plantago lanceolata L.	9	2.087
Zaječarska 83	Negotin	Red sorrel - Rumex acetosella L.	9	0.256
		Wild sorghum - Sorghum halepense (L.) Pers.	7	2.442
		Charlock mustard - Sinapis arvensis L.	8	1.413
		Redroot pigweed -Amaranthus retroflexus L.	5	0.448
		Redroot pigweed -Amaranthus retroflexus L.	7	0.445
		Red sorrel - Rumex acetosella L.	7	0.335
		Ribwort plantain -Plantago lanceolata L.	2	1.912
		Wild sorghum - Sorghum halepense (L.) Pers.	12	3.745
Banat	Banatsko Karađorđevo	Curly dock - Rumex crispus L.	7	1.672
		Charlock mustard - Sinapis arvensis L.	4	1.035
		Wild sorghum - Sorghum halepense (L.) Pers.	10	3.946
		Curly dock - Rumex crispus L.	9	1.615
		Redroot pigweed -Amaranthus retroflexus L.	9	0.456
		Field dodder - Cuscuta campestris Yunk.	9	1.475
		Ribwort plantain -Plantago lanceolata L.	7	1.941
		Charlock mustard - Sinapis arvensis L.	5	1.223
Kruševačka 28	Srpska Crnja	Red sorrel - Rumex acetosella L.	9	0.389
		Curly dock - Rumex crispus L.	60.09	34.41
		Red sorrel - Rumex acetosella L.	27.22	18.84
		Ribwort plantain -Plantago lanceolata L.	51.93	10.68
		Charlock mustard - Sinapis arvensis L.	36.74	20.37
		Wild sorghum - Sorghum halepense (L.) Pers.	14.78	10.99
		Field dodger - Cuscuta campestris Yunk.	29.04	13.69
		Variability expressed through the coefficient of variation (CV%) for the number of seeds and the mass of 1000 weed seeds		

Table 3. Number and weight of 1000 weed seeds in lots of natural alfalfa seeds in 2022

CONCLUSION

A high variability of the weed seed number was determined during 2020 from CV% = 34,64 (red sorrel - *Rumex acetosella* L.), to 65.47 (ribwort plantain - *Plantago lanceolata* L.). During 2021, variability was determined from CV%=33.32 (red sorrel - *Rumex acetosella* L.) to CV% = 48.58 (wild sorghum - *Sorghum halepense* L. Pers.). On samples from 2022 variability varied from CV% = 14.78 (wild sorghum - *Sorghum halepense* L. Pers.) to CV% = 60.09 (curly dock - *Rumex crispus* L). A slightly lower variability was determined for the mass of 1000 seeds: from CV% = 5.869 (ribwort plantain - *Plantago lanceolata* L.) to CV% = 13.40 (wild sorghum - *Sorghum halepense* L. Pers.) on weed seeds from 2020; from CV% = 9.052 (curly dock - *Rumex crispus* L.) to CV% = 19.27 (wild sorghum - *Sorghum halepense* L. Pers.) on seeds from 2021; and from CV% = 10.68 (ribwort plantain - *Plantago lanceolata* L.) to CV% = 34.41 (curly dock - *Rumex crispus* L.) on seeds from 2022. The obtained results indicate all the complexity for determining the optimal finishing system to be applied for cleaning weed seeds from natural alfalfa seeds.

Key words: Number of weed seeds, natural alfalfa seeds, weight of 1000 weed seeds.

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