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Lentil Yield Performance and Quality as Affected by Moisture Supply

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ABSTRACT
The article presents alternatives for the use of additional components of cultivation technology for lentil that are aimed at increasing tolerance to a water deficiency at the early stages of growth and development, namely: (i) soil amendment with moisture-retaining polymers; (ii) seed treatment with a growth regulator contributing to a better formation of the root system; (iii) the use of biological product providing for the formation of the soil mycorrhizal biota; and (iv) foliar application of micro fertilizers. The best in terms of the effect on the growth and development of plants appeared the following treatments: seed treatment with the growth regulator Kelpak SC (3 l/t), soil amendment with moisture-retaining polymers Aquasorb (200 kg/ha) and mycorrhizal bio preparation Mycofriend (1 l/ha), followed by the treatment of plants with micro fertilizer Reakom-SP-Legumes (3 l/ha, BBCH 14) or Quantum-Legumes (1.0 l/ha, BBCH 14). These treatments contributed to an increase in the number of stems of the 2nd and 3rd orders by 1.8 and 2.0, leaves by 8.6 and 8.8, and nods by 15.3 and 16.1, respectively, compared to the control treatment. In addition, a combination of these plant products had a positive impact on the formation of filled beans, and the plants formed 23.5–23.7 filled beans. Also, these treatments provided 1.6–1.8 times increase in the number of seeds per bean compared to the control. Pre-sowing seed treatment with the growth regulator Kelpak SC (3 l/t), application of moisture-retaining polymers Aquasorb (200 kg/ha) and mycorrhizal bio preparation Mycofriend (1 l/ha), followed by foliar application of fertilizers Reakom SC Legumes (3 l/ha, BBCH 14) or Quantum-Legumes (1.0 l/ha, BBCH 14) contributed to the formation of lentil yield of 3.15 and 3.17 t/ha, respectively, over the years of the experiment. The integral action of these plant products contributed to obtaining seeds with a higher content of proteins, fats, and carbohydrates, as well as vitamins, macro and microelements. Moreover, young lentil sprouts can resist adverse environmental factors due to the richer biochemical stocks formed in a seed.

Keywords: moisture-retaining polymers, growth regulator, mycorrhiza, micro fertilizer.

INTRODUCTION

Growing legumes is a quite effective way to ensure the population's need for high-quality protein as these crops have comparatively low water consumption. To produce 1 kg of lentil seeds requires 50 l of water, while to produce 1 kg of chicken meat needs 4325 l, lamb 5520 l, and beef 13000 l. The low water consumption per 1 protein unit production makes legumes an optimal choice in dry climates and regions prone to drought (Hajong et al, 2020; Zhang et al, 2019).

However, lentil has critical periods in terms of water consumption. Therefore, one of the main causes of low lentil yield in many regions is water stress (Sarker et al, 2002a; Sarker et al, 2002b). For example, 80% of the range in lentil seed yield in the Mediterranean climate may be explained by the difference in seasonal precipitation, as the greatest precipitation falls in winter, while in the period from March to May, plants are exposed to water and temperature stresses (Erskine et al., 1994).

Therefore, there is a thought that lentil belongs to moisture-demanding plants, especially in the flowering stage. However, in terms of resistance to drought and heat, lentil outperform pea (Kahraman et al, 2016). These data are also confirmed by other authors; nevertheless, they indicate that lentil is extremely sensitive to moisture shortage in the period from seed swelling to germination (Kassab et al, 2014).

Another critical in terms of the need for moisture stage is flowering. In the period from bean formation to ripening, plants are better adapted to the deficit of moisture, and in the ripening stage, a large amount of moisture in the soil has a rather negative impact (Liu et al, 2019; Ramegowda and Senthil-Kumar, 2015).

Therefore, to avoid the stress on lentil from the lack of moisture in the soil, the timing of sowing and further development of plants should be adjusted to the period of moisture availability in the soil. Such requirements are suitable for the varieties with the early and rapid development of biomass and flowering (Sarker et al., 2002a; Sarker et al., 2002b). Also, lentil seeds are usually sown earlier in the spring, which can also shorten the period when plants are exposed to water stress (Miah et al, 2021).

To germinate, a lentil seed needs water in the amount of 100−120% of its weight. With time, as the root system develops, plants can use moisture from the lower soil layers better than cereal crops, and the need for water decreases. However, frequent dry periods during the flowering and grain formation period cause great damage to lentil plants. Studies have found that large-seeded lentil varieties suffer from dryness more than small-seeded ones. At the same time, lentil can flower and bear fruit again after the rain in the second half of the vegetation. With an excessive amount of moisture during the flowering and grain formation stages, the growing season of lentils is extended, with the plants being heavily affected by rust and forming an excessive green mass, which leads to a decrease in the grain yield and quality (Pandey et al, 2017). According to experimental data, 150–200 mm of productive rainfall during the growing season is quite enough for lentil to form a good high-quality yield (Cherenkov et al., 2013).

Lentil plants are better adapted to soil drought than to atmospheric drought during the flowering stage. Particularly large damage at this time is caused by dryness, under the influence of which flower stalks quickly dry up and twist, which causes significant fall of buds and flowers (Classen et al, 2015; Foti et al, 2021).

Researchers give rather diverse values of water consumption by lentil. Thus, in New Zealand, the water use efficiency per dry matter of yield (from 1 ha per mm of rainfall) ranges from 13.2 to 28.1 kg/ha (McKenzie, Hill, 2004). In Southwest Australia, water consumption is about 30 kg/ha (Siddique et al., 1998) and in Nepal 18.3 kg/ha, while in Syria it is13.7 kg/ha (Zhang et al, 2000). At the same time, much less water is consumed to produce grain than to form the dry matter. According to various authors, the values for the grain range from 4.8 to 7.76 kg/ha (McKenzie, Hill, 2004), 6.3 kg/ha, (Shrestha et al, 2005), 3.8 kg/ha (Zhang et al., 2000), 11 kg/ha (Siddique et al., 1998), and from 7.6 to 10.4 kg/ha (Lal et al., 2007).

Excessive rainfalls, in turn, cause the lodging of lentil crops. In dry years, when no more than 1.5 t/ha of biomass is formed, there is practically no lodging observed. However, when biomass exceeds 3.0 t/ha, yield losses can increase up to 40% (Erskine et al., 1994). Therefore, the development of irrigation systems for lentils is not a good way to overcome the moisture-related stress in plants.

MATERIALS AND METHODS

Field experiments were carried out in the zone of unstable soil moisture at the Uladivske-Liulyntsi Experimental Breeding Station (49°34’30.7”N 28°22’39.5”E) in the years 2015−2020. The experimental design is shown in Table 1.

Moisture-retaining polymers Aquasorb were introduced under early spring tillage using an Amazone ZA-TS 3200 spreader. Mycorrhizal-forming bio preparation Mycofriend (1 l/ha) was applied to the soil immediately before cultivation with a hinged field sprayer Amazone UF at a working fluid consumption rate of 200 l/ha.

The soil of the experimental field was deep low-humus medium-loam chernozem. The content of humus was 3.9% (by the Tyurin and Kononova method), and the reaction of the soil solution was weak acid, close to neutral. The content of nitrate-nitrogen was 16.4 mg/kg, ammonium nitrogen 38.7 mg/kg, mobile phosphates 83 mg/kg (by the Chirikov method) and exchangeable potassium 103 mg/kg (by the Chirikov method). Availability of mineral nitrogen (nitrate + ammonium) was medium, phosphorus – low and exchangeable potassium – increased.

Analysis of weather conditions shows that in April–July 2015–2020, the air temperature was

Table 1. Scheme of the experiment on lentils to study the factors of increasing tolerance to water deficiency at early stages of growth and development

Moisture-retaining agent	Soil amendment	Growth regulator	Micro fertilizers	Treat-ment
Control	Control	Control	Control	1
			Reakom-SP-Legumes (3 l/ha, BBCH 14)	2
			Quantum Legumes (1.0 l/ha, BBCH 14)	3
		Kelpak SC (3 l/t) seed treatment	Control	4
			Reakom-SP-Legumes (3 l/ha, BBCH 14)	5
			Quantum Legumes (1.0 l/ha, BBCH 14)	6
	Mycorrhizal-forming bio preparation Mycofriend (1 l/ha)	Control	Control	7
			Reakom-SP-Legumes (3 l/ha, BBCH 14)	8
			Quantum Legumes (1.0 l/ha, BBCH 14)	9
		Kelpak SC (3 l/t) seed treatment	Control	10
			Reakom-SP-Legumes (3 l/ha, BBCH 14)	11
			Quantum Legumes (1.0 l/ha, BBCH 14)	12
Moisture-retaining polymers Aquasorb (200 kg/ha)	Control	Control	Control	13
			Reakom-SP-Legumes (3 l/ha, BBCH 14)	14
			Quantum Legumes (1.0 l/ha, BBCH 14)	15
		Kelpak SC (3 l/t) seed treatment	Control	16
			Reakom-SP-Legumes (3 l/ha, BBCH 14)	17
			Quantum Legumes (1.0 l/ha, BBCH 14)	18
	Mycorrhizal-forming bio preparation Mycofriend (1 l/ha)	Control	Control	19
			Reakom-SP-Legumes (3 l/ha, BBCH 14)	20
			Quantum Legumes (1.0 l/ha, BBCH 14)	21
		Kelpak SC (3 l/t) seed treatment	Control	22
			Reakom-SP-Legumes (3 l/ha, BBCH 14)	23
			Quantum Legumes (1.0 l/ha, BBCH 14)	24

The single plot area 35 m^2 and 25 m^2, 4 replications.

higher compared to the average long-term data, and precipitation was uneven.

The moisture available to plants in the soil layer of 0–20 cm in 2015 at the time of sowing was 35 mm, while with the use of the moisture-retaining agent Aquasorb it was 38 mm, which corresponds to satisfactory reserves. Similarly, moisture reserves were satisfactory in 2016, 2019, and 2020 and good in 2017 and 2018.

In 2015, at the time of flowering, the moisture reserves in the soil layer of 0–20 cm decreased to 4–7 mm, which was unsatisfactory. Similarly unsatisfactory levels were also in 2017, while 2016, 2018, 2019, and 2020 were satisfactory in terms of moisture reserves.

The use of moisture-retaining polymers Aquasorb ensures an additional 3 mm of moisture available to plants during the growing season in the soil layer of 0–20 cm. General and special agronomic methods were used to carry out field experiments (Prysiazhniuk et al, 2021). The measurement of plant biometrics was carried out by sampling 50 plants per replication. Yield records were performed in a plot-by-plot manner, with the grain moisture adjusted accordingly. The biochemical component (the content of protein, starch, fat, fiber, and moisture) was determined according to DSTU 4117:2007. Mineralization of seed samples was determined according to DSTU 7670:2014. The content of trace elements was determined by the method of atomic absorption spectrometry and vitamins by liquid chromatography using the Chromos LC-301 analyzer.

Statistical analysis was performed using the ANOVA method using the Statistica 12 software (Ermantraut et al, 2007).

RESULTS

Biometric indicators of lentil plants allow us to determine the optimal method of supplying moisture to plants, as they may be affected by both excessive and insufficient soil moisture (Table 2).

Table 2. Biometric indicators of lentil plants, the average for 2015–2020

Treatment	Number per plant						Height (cm)		Weight (g)		
	2nd and 3rd order stems	Leaves	Nodes	Beans	Beans with seeds	Seeds	Plants	Attachment of the lowest bean	Plants	Seeds per plant	1000-seed weight
1	6.2	12.8	39.4	23.2	12.3	19.3	35.5	19.5	3.0	1.2	64.2
2	6.4	14.4	40.6	25.9	13.9	20.5	36.5	19.9	3.3	1.3	65.7
3	6.2	14.0	40.9	26.2	14.0	20,6	36.3	19.8	3.3	1.4	65.6
4	6.7	16.0	42.0	28.9	15.5	22.8	37.0	19.6	3.7	1.5	66.0
5	6.5	17.4	42,5	30.8	16.6	24.3	38.2	19.9	4.0	1.6	66.2
6	6.8	17.2	42.3	30.9	16.6	24.4	38.0	20.3	4.0	1.6	66.1
7	6.5	16.3	44.8	26.3	14.2	20.9	39.2	19.7	3.4	1.4	65.7
8	6.6	16.5	45.0	28.0	15.2	22.4	39.6	20.2	3.6	1.5	65.9
9	6.3	16.4	45.0	28.3	15.4	22.7	40.0	20.0	3.7	1.5	66.3
10	6.9	17.9	47.4	31.0	16.8	24.8	42.0	19.6	4.0	1.6	65.9
11	7.0	18.0	48.0	32.7	17.9	26.2	44.0	19.4	4.3	1.7	66.5
12	6.9	18.0	48.3	32.9	18.0	26.5	43.5	19.5	4.3	1.8	66.3
13	7.2	15.1	43.3	26.3	16.5	24.3	37.9	19.3	3.9	1.6	65.4
14	7.1	17.0	45.9	29.1	18.0	26.5	38.2	20.0	4.3	1.7	65.8
15	7.3	16.6	45.8	29.5	18.1	26.7	39.0	19.5	4.3	1.8	65.9
16	7.6	18.9	47.5	32.3	20.1	29.6	42.1	19.3	4.8	2.0	66.0
17	7.7	20.6	48.6	34.6	21.5	31.7	43.3	19.4	5.1	2.1	66.3
18	7.4	20.4	48.2	35.1	21.7	32.0	43.0	20.6	5.2	2.1	66.0
19	7.5	19.3	51.1	29.7	18.2	26.9	44.4	19.9	4.4	1.8	66.3
20	7.6	19.6	51.5	31.6	19.5	28.8	45.0	20.5	4.7	1.9	67.0
21	7.4	19.4	51.4	32.2	20.0	29.6	46.0	19.2	4.8	2.0	66.8
22	7.8	21.2	53.6	35.5	21.9	32.3	47,2	19.6	5.3	2.2	66.7
23	8.0	21.4	54.7	38.2	23.5	34.7	48.0	19.4	5.7	2.3	66.9
24	8.2	21.8	55.5	38.2	23.7	35.1	48.0	20.0	5.7	2.3	66.7
$LSD_{0.05}$	0.3	0.6	0.5	1.0	0.7	1.1	1.5	2.3	0.05	0.03	1.8

The studied additional components of the cultivation technology contributed to the formation of a larger number of stems of the 2nd and 3rd orders. To illustrate, in the control treatment, the number was 6.2 stems per plant, while in treatments 23 and 24 it was 8.0–8.2. Similarly, in the control treatment, the number of leaves per plant was 12.8 and nodes 39.4, while in the treatments 23 and 24 the number of leaves was 21.4–21.8 and nodes 54.7–55.5.

Seed treatment with growth regulator Kelpak SC together with soil amendment with moisture-retaining polymers Aquasorb and mycorrhizal bio preparation Mykofriend and foliar fertilization with micro fertilizer Reakom-Legumes or Quantum-Legumes (BBCH 14) contributed to the formation of 23.5–23.7 of filled beans per plant. Similarly, 19.3 seeds per plant were obtained in the control treatment, while the experimental treatments 23 and 24 provided the formation of 14.0–15.4 seeds per plant, which was 1.6–1.8 times more than in the control.

The average height of plants in the experiment was 41.3 cm. Treatments 23 and 24 did not lead to radical overgrowth of plants: regardless of the increase in height by 6.7 cm being statistically significant, it was rather insignificant from the agronomic point of view. However, for the average height of the attachment of the lowest bean, a 19.8 cm deviation over the treatments was within the error of the experiment.

Plant weight was 3.0 g in the control and increased to 5.7 g in the best treatments. The increase was due to the formation of additional seeds per plant: the weight of seeds per plant increased from 1.2 to 2.3 g per plant. However, the ratio between the weights of seeds and plants, and the 1000-seed weight varied over the experimental treatments insignificantly. This was possible due to studying those components of the cultivation technology that affect these features indirectly.

Although lentil is a drought-resistant crop, the application of moisture-retaining polymers

Aquasorb (200 kg/ha) to the soil contributes to a higher yield of seeds. It was by 0.69 t/ha higher than in the treatments without the use of hydrogel (moisture-retaining polymers) (Table 3).

Moisture-retaining polymers interacted quite well with the mycorrhiza-forming bio preparation Mycofriend and seed treatment with the growth regulator Kelpak SC. Therefore, seed treatment with the growth regulator Kelpak SC (3 l/t) together with the application of moisture-retaining polymers Aquasorb (200 kg/ha) and mycorrhizal bio preparation Mycofriend (1 l/ha), followed by foliar fertilization with micro fertilizers Reakom-SP-Legumes (3 l/ha, BCHH 14) or Quantum-Legumes (1.0 l/ha, BBCH 14) contributed to the formation of lentil yield over the years of research at the level of 3.15 and 3.17 t/ha, respectively.

Among the factors influencing the increase in lentil yield, we can distinguish the important value of the moisture-retaining agent, which provided for 28% of the yield increase, while the growth regulator provided for 21%, the mycorrhizal-forming product 13%, and micro fertilizers 10% (Fig. 1).

In terms of the effect on the crude protein content, mycorrhizal-forming bio preparation Mycofriend demonstrated the best results. Its application contributed to a 0.51% higher protein content, while its combination with moisture-retaining polymers Aquasorb guaranteed 0.89% more crude protein in seeds compared to treatments without hydrogel. However, the higher starch content values were promoted by the use of Kelpak SC for seed treatment, especially in combination with moisture-retaining polymers Aquasorb.

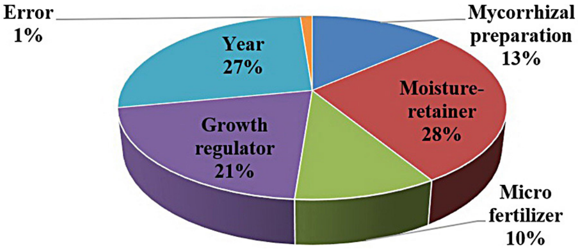

Figure 1. Share of influence of the experimental factors on the increase in lentil yield

Table 3. The yield of grain, the content and yield of crude protein and starch in lentil, the average for 2015–2020

Treatment	Yield, t/ha	Crude protein, %	Crude protein yield, t/ha	Starch content, %	Starch yield, t/ha
1	1.58	25.63	0.40	52.30	0.82
2	1.73	25.70	0.44	52.21	0.90
3	1.74	25.72	0.45	52.33	0.91
4	1.94	25.81	0.50	52.30	1.01
5	2.08	25.90	0.54	52.50	1.09
6	2,09	25.93	0.54	52.52	1.10
7	1.79	26.02	0.47	52.35	0.94
8	1.93	26.10	0.50	52.40	1.01
9	1.97	26.08	0.51	52.44	1.03
10	2.16	26.40	0.57	52.82	1.14
11	2.30	26.60	0.61	52.80	1.22
12	2.31	26.56	0.61	52.89	1.22
13	2.09	25.75	0.54	52.90	1.10
14	2.30	25.84	0.60	53.02	1.22
15	2.32	25.90	0.60	53.08	1.23
16	2.59	26.00	0.67	53.35	1.38
17	2.80	26.03	0.73	53.46	1.50
18	2.81	26.08	0.73	53.40	1.50
19	2.41	26.60	0.64	53.48	1.29
20	2.61	26.80	0.70	53.53	1.40
21	2,67	26.80	0.72	53.50	1.43
22	2.93	26.83	0.78	53.62	1.57
23	3.15	26.90	0.85	53.59	1.69
24	3.17	27.01	0.86	53.63	1.70
$LSD_{0.05}$	0.16	0.36	0.06	0.78	0.02

Analysis of the results of field experiments allowed to identify better options for the complex application of the studied factors. Therefore, let us consider the changes in the biochemical composition of the grain over the experimental treatments in comparison with the control (Table 4).

Raw protein consists of two groups of substances – protein and amides (nitrogenous substances of non-protein origin). Therefore, there is less protein in lentil seeds. However, the seeds also contain carbohydrates, namely starch, complex high molecular weight polysaccharides. Therefore, the differences in data between proteins and carbohydrates in Tables 3 and 4 are quite natural.

In general, the use of the studied components of cultivation technology together (treatment 24) contributed to the formation of a higher content of proteins, fats, and carbohydrates, as well as vitamins, macro and microelements in lentil seeds. That is, the provision of plants with moisture and nutrients had a positive impact on the formation of high-quality seeds.

The application of the studied components of cultivation technology is especially important when caring for seed crops: when sowing seeds obtained in the best treatments, more nutrients were available in the germinated seeds. This made young lentil sprouts able to resist adverse environmental factors, due to the richer biochemical reserves formed in the seed.

DISCUSSION

Analysis of the literature and statistical information allows us to conclude that in most regions, lentil is grown without watering (Sinha 1977) and under such conditions, its yield is extremely low. For example, in 2018, the average yield in Iran was 0.54 t/ha and in India 0.73 t/ha. However, on

Table 4. Biochemical composition of lentil grain, the average for 2015−2020

Composition	Treatment 1		Treatment 24	
	Dry grain	Sprouted grain	Dry grain	Sprouted grain
Proteins (g)	23.94	8.97	25.01	10.20
Fats (g)	2.19	0.57	2.00	0.77
Carbohydrates (g)	52.5	22.17	55.00	26.80
Dietary fiber (g)	10.9	-	8,60	-
Ash (g)	3.00	1.00	3.00	1.00
Water (g)	7.85	67.44	8.12	71.22
Vitamins				
A (μg)	3.00	2.00	3.00	2.30
B1 (mg)	530	0.229	0.640	314
B2 (mg)	0.108	0.129	0.116	0.121
B9 (μg)	206	100	234	205
B5 (mg)	0.345	0.579	0.389	516
B6 (mg)	0.409	0.22	0.503	0.306
C (mg)	1.8	16.7	2.2	17.1
PP (mg)	1.498	1.126	1,512	1,201
Macro and microelements				
K (mg)	672	325	700	344
Ca (mg)	45.0	27.0	47.0	22.0
Mg (mg)	61.0	35.0	65.0	33.0
S (mg)	236.8	91.2	235.1	89.0
Fe (mg)	7.43	3.25	7.56	3.12
Mn (mg)	1,712	0.534	1.717	0.502
Cu (μg)	1305	356	1300	307
Na (mg)	7.00	12.00	7.00	15.00
P (mg)	296	171	277	166
Se (mg)	0.02	0.60	0.02	0.50
Zn (mg)	3.80	1.55	3.20	1.12

the soils provided with sufficient moisture in such countries as New Zealand, the United Kingdom, and Canada, the yield was 2.35, 3.00, and 1.40 t/ha, respectively (FAO stat 2020).

Irrigation during drought-critical periods of vegetation season allows for increasing productivity by 51%, and the maximum yield was obtained with single irrigation during flowering (Lal et al., 2007). Other scientists did not find a significant difference in the yield of lentil that was not irrigated before flowering and then watered at a full rate, and the lentil that received the full rate of irrigation before flowering and later was not watered (McKenzie and Hill, 2004). Therefore, the use of moisture-retaining agents is an interesting alternative to irrigation.

The content of protein, fat, and fiber varies considerably under the effect of cultivation practices and, especially, under the conditions of moisture provision. Protein accumulation in arid conditions occurs much more intensively (Cherenkov et al., 2013; Prysiazhniuk et al., 2020; Bonfante and Genre, 2015). Also, foliar application of microelements Zn and Mn contributed to the formation of high seed quality and protein content in seeds.

Many studies on the foliar application of micro fertilizers can significantly increase biomass and yield. Among them are Zn (Khurana et al., 1998), Mn, Fe (Clark and Zheng, 2017, Mo (Biswapati et al., 1998), and B (Srivastava et al., 2000). Also, boron deficiency causes leaf chlorosis and low yields in Nepal, India, and the United States (Leng and Hall, 2019). The application of 0.5 kg/ha of boron increased the yield from 0.1 to 1.5 t/ha (Srivastava et al., 1999).

Consequently, the use of the studied components of the cultivation technology has a positive effect on the growth and development of lentil. Therefore, the combination of these components in the crop cultivation technology ensures the formation of lentil sowings resistant to water deficiency and high efficiency of crop production in general.

CONCLUSIONS

It was found that seed treatment with the growth regulator Kelpak SC, soil amendment with moisture-retaining polymers Aquasorb and mycorrhizal bio preparation Mycofriend together with foliar application of micro fertilizers Reakom-SP-Legumes or Quantum-Legumes (BBCH 14) contributed to the formation of a larger (compared to the control) number of stems of the 2nd and 3rd orders – by 1.8 and 2.0, leaves by 8.6 and 8.8, and nodes by15.3 and 16, respectively. This had a positive impact on photosynthetic activity, as well as the resistance of plants to lodging because the better treatments (23 and 24) did not lead to radical overgrowth of plants, since the growth of plant height by 6.7 cm is insignificant from an agronomic point of view.

It was also found that the combined use of plant products Kelpak SC, Aquasorb, Mycofriend, micro fertilizers Reakom-SP-Legumes or Quantum-Legumes (BBCH 14) had a positive impact on the number of filled beans per plant (23.5–23.7 in the studied treatments), as well as increased the number of seeds in a bean (1.6–1.8 times).

It has been investigated that seed treatment with the growth regulator Kelpak SC (3 l/t), application of moisture-retaining polymers Aquasorb (200 kg/ha), mycorrhiza-forming bio preparation Mycofriend (1 l/ha), followed by foliar application of micro fertilizers Reakom-SP-Legumes (3 l/ha, BBCH 14) or Quantum-Legume (1.0 l/ha, BBCH 14) contributed to the formation of lentil yield over the years of research at the level of 3.15 and 3.17 t/ha, respectively.

The integral action of these plant health products contributed to obtaining seeds with a higher content of proteins, fats, and carbohydrates, as well as vitamins, macro and microelements. Moreover, young lentil sprouts can resist adverse environmental factors due to the richer biochemical stocks formed in a seed.

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