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The Effect of Seeding Rate on the Growth, Development and Yield Capacity of Lentil Cultivated in Vardenis Province of the Gegharkunik Region

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ABSTRACT

The current studies are related to the efficiency of the seeding rate variants determined for the fine seed lentil variety "Armyanskaya 88". The experiments were carried out in 2017-2018, in conditions of Tsovak community of the Gegharkunik region.

In the dry soils of Vardenis province in the Gegharkunik region, the lentil plant ripens in 88-92 days (the first ten days of August) and can be proper precursor for the winter wheat. Based on the mathematical processing data of the seed yield capacity and the received profit it is recommended to sow the small-seeded lentil with the rate of 2.7 mln viable-seed/ha in the land areas of Vardenis province in the Gegharkunik region and in other zones with similar climatic conditions.

Introduction

Lentil is an important food crop; its seeds are used in food products and food industry, particularly in the production of protein preparations, sausage and canned products, as well as in confectionary and pastry factories (Posypanov, 2006).

Lentil is second only to soybean in the content of protein (32 %) (Matevosyan, 2000). It is rich in indispensible/ essential amino acids, 10 of which sum to 147 g/kg in the dry matter of the seed.

The forage value of the straw and lentil threshing yield is also rather high, which contains 14 %-18 % proteins and its 1 kg is equal to 0.56 feed unit (Posypanov, 2006, Khachatryan, 1970).

Due to the great significance of the lentil in the food ration of the population, the extension of the crop cultivating areas is among the prior issues for the agriculture of Armenia, the implementation of which will enable to meet the population's demand for lentil.

The agro-technical value of the lentil is also extremely high. Lentil is a crop of Fabaceae family and the tuber bacteria, dwelling on the lentil roots and binding the atmospheric nitrogen to the soil, annually leave 40-100 kg/ha nitrogen in the soil on the average, thereby improving the soil quality. Considering the mentioned fact, it can be stated that lentil is also the best precursor for a number of crops.

Lentil is a relatively drought-hardy, less nutrient-demanding plant with short vegetation period and thus, it

is rather valued in the mountainous regions of the Republic of Armenia as a beneficial forecrop. It is cultivated in the Aragatsotn, Kotayk, Gegharkunik, Vayots Dzor and Syunik regions of the RA. As of 2017, their crop lands covered 81 ha and the average yield capacity was 13.8 c/ha (Statistical Bulletin of Armenia, 2015).

There are numerous investigations worldwide related to various lentil varieties and their seeding rates. Prior to our investigations we studied some research results (Ashiq Saleem, 2012).

The seed yield capacity of lentil is usually low, which is mainly due to agro-technical reasons and partially to the identification of the seeding rate as well. The latter needs to be regulated based on the soil and climatic conditions, which is exactly pursued in the current work.

Materials and methods

The studies were carried out in 2017-2018 in conditions of Tsovak community in the Gegharkunik marz/region. Black, dry (rainfed) and mountainous soils are characteristic to the mentioned community. The average annual precipitation rate is 450-500 mm and the average temperature amounts to 4.6-5.1 ^{0}C.

The experiments were set up in 4 repetitions with 10 m^2 experimental beds; the preceding plant was spring barley. The efficiency of different seeding rates with the variants of *2.1, 2.4, 2.7, 3.0* and *3.3 mln viable-seed/ha* for the fine seed lentil variety "Armyanskaya 88" was investigated.

Phenological observations, biometric measurements and calculation of the biological yield of straw and grain were conducted according to the accepted methods during the vegetation period. The mentioned observations were conducted within the period starting from the sowing up to harvesting times. i.e. during the plants growth and development period. The main objective of the mentioned activities is to register the plants developmental phase transitions.

The phenological observations were carried out through the visual methods during which the germination, budding and vegetation durations (by days) per individual variants were determined.

When speaking about the phenological phase, the manifestation of the external morphological properties of the given plant is meant. For each phase the data are recorded twice: at the start, when 10 % of the plants are involved in the mentioned phase and at the end, when 60 %-75 % of the total plant number (mass examination) is within the scope of observation (Khachatryan, 2002).

In the lentil experimental field the germination capacity and plants density were determined according to the methodology accepted for field experiment conduction per 1 m^2 field area; it was repeated twice - after the full germination and on the eve of harvest.

The plants height, the weight of the entire plant and its grains were calculated for 25 plants from each bed. Based on the data resulted from the grains and straw weight per 1 m^2 field area, the biological yield for 1 ha field area was estimated, which enabled to evaluate the lentil yield capacity in different variants of seeding rates.

Results and discussions

Lentil is cultivated on very small land areas in Gegharkunik region. Besides, the complex of agro-technical measures aimed at its cultivation is not completely examined yet. Determination of the best seeding rate is considered to be one of the vital technological measures for the plant cultivation, in case of which it becomes possible to get high yield with low cost price.

The plants number in the cultivated unit area is related to the seeding rate, while the field germination capacity of the seeds and the duration of the vegetation depends on the developmental transition phases of the plant. The results of the mentioned experiments are introduced in table 1.

The table data testify that the sowing was implemented in the best time period (26.04) for the given area. The germination of the lentil seeds was recorded 8-10 days after sowing (05.05-07.05) and the variants of the seeding rates were not significant for the duration of the germination phase. The effect of the seeding rate was noticeable in the further developmental and growing phases of the lentil plant. For example, budding, blossoming and maturation processes occurred earlier in the variant with low seeding rate (2.1 mln viable-seed/ha), where the mentioned phases were fixed on 21.06, 02.07 and 01.08 respectively.

Together with the increase of the seeding rate the budding phase was delayed gradually by 4 days, blossoming phase - by 5 days and ripening - by 6 days. The mentioned phases were recorded on 25.06, 07.07 and 07.08 respectively in case of high seeding rate.

The data on the vegetation duration (germination-ripening) were of particular interest. In case of low seeding rate (2.1 and 2.4 mln viable-seed/ha) the lentil ripened within 88-89 days, while at relatively higher rates (3.0 and 3.3 mln viable-seed/ha) it occurred in 92 days. In relatively favorable nutritional, humidity and light conditions, which is marked in the variant of low seeding rate, the lentil ripens up to 4 days faster.

Table 1. The growing and developmental phase transitions in lentil plant*

Variants mln. viable-seed, kg/ha		Recording date					Vegetation duration, day
		Seeding	Germination	Budding	Blossoming	Ripening	
1 2.1	73.2	26.04	05.05	21.06	02.07	01.08	88
2 2.4	84.4	26.04	05.05	21.06	03.07	02.08	89
3 2.7	94.8	26.04	06.05	23.06	04.07	04.08	90
4 3.0	105.3	26.04	07.05	23.06	06.07	07.08	92
5 3.3	115.9	26.04	07.05	25.06	07.07	07.08	92

Table 2. Field germination capacity of the lentil, the density and height of vegetation cover and the yield capacity*

Variants mln./viable seed	Field germination capacity, %	Number of plants at the harvest time, n/m²	Plants height, cm	Weight, g/m²		Biological yield, c/ha			Profit, thousand AMD
				entire plant	seeds	straw	seed	surplus %	
1. 2.1	84.7	169	32.4	278	136	14.2	13.6	100	534.9
2. 2.4	84.1	190	32.0	300	148	15.2	14.8	108.8	587.1
3. 2.7	83.0	210	31.9	340	167	17.3	16.7	122.8	674.8
4. 3.0	82.3	232	31.0	350	171	17.9	17.1	125.7	677.4
5. 3.3	79.7	246	30.5	362	172	19.0	17.2	126.4	675.0

E_x%=2.5 %, $LSD_{0.95}$=1.2 c/ha

*Composed by the authors.

The results of the experiments have disclosed that the seeding rate has somehow influenced lentil seeds germination capacity, plants preservation and their height, as well as the yield capacity and profitability of straw and seeds (Table 2).

In dry conditions the field germination capacity of the seeds is high (84.7 %) in the variant of low seeding rate, which, anyhow, swings down to 5 % in the other applied variants. Such regularity has been also fixed regarding the data on the plants height. Thus, the plants are high in the sparse sowings (169 n/m²) stretching up to 32.4 cm and they are relatively lower in the dense ones (246 n/m²) - 30.5 cm.

It has been also revealed that parallel to the increase of the seeding rate, the yield capacity of the lentil straw and seed grows up to 14.2-19.0 c/ha and 13.6-17.2 c/ha respectively, besides, the seed yield capacity sharply increases in the variant of 2.7 mln viable-seed, amounting to 16.7 c/ha, whereafter the increase of the seeding rate results in little growth of yield capacity amounting only to 0.4-0.5 c/ha. The surplus of the seed yield amount has fluctuated within the range of 8.8 %-26.4 %.

Any agricultural measure is evaluated from the perspective of reliable mathematical processing of the yield amount data and from that of indices of the resulted profits. The least significance difference (1.2 c/ha) in the estimated yield of our experiments is true (valid) for the first, second and third variants of the seeding rate, while for the next two variants it is not true (invalid), since their difference is lower than 1.2 c/ha and makes only 0.4-0.5 c/ha.

The profit, which was calculated upon the difference of the resulted seed yield and their expenses, has made 534.9-677.4 thousand AMD in the variants of the mentioned seeding rates. The gradual course of culmination has been observed up to the variant of 2.7 mln viable-seed (674.8 thousand AMD), whereafter the profit increase slowed down (0.2-0.6 thousand AMD).

Conclusion

By the experimental results it has been found out that the seeding rate has demonstrated certain effect on the field germination capacity of the lentil seeds, on the plants preservability and height, as well as on the yield capacity and profitability of straw and seeds.

In the rainfed/dry soils of Vardenis province in the Gegharkunik region the lentil ripens within 88-92 days (the first ten days of August) and it can be a promising precursor for the winter wheat. Based on the mathematical processing data on the seed yield amount ($E_x\%=2.5\ \%$, $LSD_{0.95}=1.2$ *c/ha*) and the recorded profit, it is recommended to sow the small-seeded lentil with the rate of 2.7 mln viable-seed/ha in Vardenis province of the Gegharkunik region or in other regional areas with similar climatic conditions.

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