DEVELOPMENT OF ELEMENTS OF TECHNOLOGY OF CULTIVATION OF AMARANTH IN COVER CROPS ON IRRIGATED LANDS SREDNESHIROTNYKH PLAINS OF DAGESTAN

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Summary

The data of a three-year experiment to establish the optimal irrigation regime of amaranth varieties Kizlyarets in the sowing on medium saline soils of plain Dagestan. Analysis of the data on leaf area showed that the maximum results were recorded on crops in wide way of planting with a spacing of 45 cm and a minimum on crops with a row spacing of 70 cm. When comparing the options for irrigation regime, it was revealed that the best results were recorded when pre-irrigation

moisture threshold 80-85% of the smallest moisture capacity, and the mode of irrigation at 60-65% is much lower. The higher yield of amaranth was also at the irrigation regime pre-irrigation threshold of 80-85% of the lowest moisture capacity, with a wide – row method of sowing with row spacing of 45 cm-up to 35 tons per hectare.

Keywords: amaranth, mellow, Kizlyarets, medium saline irrigated lands, methods of sowing, phenology, productivity.

In modern conditions, the field feed production is crucial not only in creating a solid feed base for livestock, but also has a great impact on the entire crop production industry in the country. More than half of the total arable land is currently used for the production of feed, more than 80% of their gross production is harvested from these lands, forage crops also serve as the basis for the biologization of agriculture, soil fertility conservation and environmental protection [1, 2, 3].

Annual crops occupy an important place in the production of green and bulky feed, as well as in the rational organization of crop rotations. The main practical problem of growing annual herbs is to increase their productivity and feed quality, especially in terms of protein content. The scientific solution to the problem of intensification of growing annual grasses includes the expansion of species and varietal composition of crops adapted to local soil and climatic conditions, the development of scientific bases for the formation of agrophytocenoses, including technological and resource parameters that determine the optimization of the production process and feed quality management. One of the important reserve of feed production are intermediate crops, such as winter and spring staging, and cover crop. It is important not only to carry out such crops with a short period of cultivation in a timely manner, but also to select crops with a short period of vegetation and intensive accumulation of green mass, and this only under irrigation conditions when creating optimal conditions for moisture [1, 3, 5].

Irrigation improves water, air, soil nutrient regimes, creates favorable conditions for the growth of crops, allows to increase the productivity of irrigated hectares by 1.5-2 times and provides a sustainable yield of agricultural products. The structure of cultivated areas on irrigated arable land contains a much larger share of forage crops than non-irrigated arable land, which largely smoothes the difference between field and fodder crop rotations [2, 4, 6, 7].

Thus, on the basis of irrigation it is possible to solve the problem of increasing the production of feed through the widespread introduction of new high-yielding varieties and hybrids of forage crops, protein-balanced and other components. These include amaranth, borschevik Sosnovsky, comfrey, mallow, etc., which give high yields of green mass during irrigation [5].

The limiting factor of amaranth cultivation in irrigated conditions of the Republic of Dagestan is the absence of varieties, as well as the undeveloped main elements of the cultivation technology (in particular, methods of sowing and irrigation regime), especially in science-bearing crops on medium saline soils of flat Dagestan. In order to solve the above problem, we conducted research in 2015-2017 according to the following scheme:

Experience: productivity of amaranth varieties of Kizlyarets under different irrigation regimes and methods of sowing:

Factor A. Irrigation Regime:

1. Vegetation watering at 60-65% the least moisture capacity.
2. Vegetation watering at 70-75% the least moisture capacity.
3. Vegetation watering at 80-85% the least moisture capacity.

Factor V. Methods of sowing:

1. Private (15 cm).
2. Wide-row (45 cm).
3. Wide-row (70 cm).

The experiment was carried out in a fourfold repetition, placement of plots was rendomized, and repetitions were systematic.

Studies have shown that the methods of sowing did not have a significant impact on the duration of the growing season. The studied variants of irrigation regimes influenced this indicator. Thus, if the control (60-65% the least moisture capacity), the average for the years of research duration was 118 days, with an increase in the pre-irrigation threshold to 70-75% the least moisture capacity and 80-85% the least moisture capacity this period increased respectively to 4-7 days. The observed difference in the duration of the growing season of amaranth, according to the variants of the experience can be explained by the fact that with the increase of the pre-irrigation threshold of soil moisture, favorable for the growth and development of plants are created, and therefore there is an increase in the growing season.

The results of our studies showed that the control (irrigation at 60-65% the least moisture capacity), the largest area of the leaf surface is marked on plots with wide – row sowing (45 cm) - 50.7 thousand m^2/ha, and the minimum figure is recorded on the third option (wide-row, 70 cm) - 49.5 thousand m^2/ha (table 1). Approximately the same dynamics was also observed in the second and third variants on the irrigation regime (irrigation at 70-75% the least moisture capacity, irrigation at 80-85% the least moisture capacity.

When comparing the options for irrigation regime, it can be seen that the appointment of vegetation irrigation with pre-irrigation threshold 70-75% the least moisture capacity, leaf area increased by 2.2, 1.8 and 1.6%, respectively. In case of application of the irrigation regime, providing for irrigation at humidity 80-85% the least moisture capacity, this figure increased by 3.6; 2.8 and 2.4%, respectively.

The characteristic of the dynamics of the leaf surface area during the years of research revealed that the highest rates were formed in 2017, and the minimum – in the growing season of 2016. The peculiarity of amaranth culture is its high productivity of photosynthesis, which provides a rapid increase in above-ground biomass. The productivity of photosynthesis is due to the fact that amaranth belongs to the forms of C_4 – plants in which the primary product of assimilation of carbon dioxide is aspartic acid.

Table 1 – the area of the leaf surface of the plants of amaranth, depending on the studied irrigation regimes and method of sowing, thousand m^2 days / ha (variety Iriston)

The mode of irrigation	Method sowing	Years of research			The average for the three years
		2015	2016	2017	
Vegetation watering at 60-65% the least moisture capacity	Private (15 cm)	50,0	49,3	50,6	50,0
	Wide-row (45 cm)	50,9	49,9	51,3	50,7
	Wide-row (70 cm)	49,5	48,9	50,0	49,5
Vegetation watering at 70-75% the least moisture capacity	Private (15 cm)	51,0	50,4	51,9	51,1
	Wide-row (45 cm)	51,7	51,1	52,1	51,6
	Wide-row (70 cm)	50,3	49,3	50,9	50,3
Vegetation watering at 80-85% the least moisture capacity	Private (15 cm)	51,8	51,0	52,5	51,8
	Wide-row (45 cm)	52,0	51,5	52,8	52,1
	Wide-row (70 cm)	50,9	49,9	51,5	50,7

The duration of leaf functioning is one of the most important indicators of photosynthetic activity of crops. The amount of photosynthetic potential in our experiments was significantly influenced by the irrigation regime. With the increase of pre-irrigation moisture threshold, the photosynthetic potential of crops also increased. Determination of the photosynthetic potential of amaranth crops in our studies showed that at the control (irrigation at 60-65% the least moisture capacity), these values according to the variants of the experiment by the methods of sowing were, respectively, 2.95; 2.98 and 2.93 thousand m^2/ha*days (table 2). With the increase of the pre-irrigation threshold to 70-75 % the least moisture capacity, these values were maximum and amounted to-3,13; 3,16 and 3,09 thousand m^2/ ha*days, and at 80-85% the least moisture capacity – 3,18; 3,24 and 3.11 thousand m^2/ha*days. The formation of such high values of PFP in the second and third variants is associated with an increase in the duration of the growing season of amaranth (table 3, 4).

The value of the crop was dependent on the size of the assimilation apparatus and the duration of the leaves, which is estimated by the net productivity of photosynthesis. In our studies, the net productivity of photosynthesis for 2015-2017 on average, by variants with irrigation regimes varied from 1.42 to 1.75 g/m^2 per day. The highest rates were observed on plots with pre-irrigation threshold of moisture 80-85% the least moisture capacity – respectively 1.71; 1.75; 1.64 g/m^2 days, and the minimum – at 60-65% the least moisture capacity – respectively 1.44; 1.47 and 1.42 g/m^2 days.

The highest productivity of amaranth, on average, the options for methods of sowing was observed in the irrigation regime providing for the maintenance of pre-irrigation moisture threshold at 80-85 % of the least moisture capacity to 31.8 t/ha. It's beyond control (60-65% the least moisture capacity), 13.2% of the variant with pre-irrigation threshold of 70-75 % the least moisture capacity – 5.3 %.

Table 2-Photosynthetic potential of amaranth crops depending on the studied irrigation regime and method of sowing, thousand m^2 days /ha (variety Kizlyarets)

The mode of irrigation	Method sowing	Years of research			The average for the three years
		2015	2016	2017	
Vegetation watering at 60-65% the least moisture capacity	Private (15 cm)	2,97	2,83	3,04	2,95
	Wide-row (45 cm)	3,00	2,87	3,08	2,98
	Wide-row (70 cm)	2,92	2,84	3,02	2,93
Vegetation watering at 70-75% the least moisture capacity	Private (15 cm)	3,14	3,00	3,24	3,13
	Wide-row (45 cm)	3,12	3,09	3,26	3,16
	Wide-row (70 cm)	3,07	2,98	3,21	3,09
Vegetation watering at 80-85% the least moisture capacity	Private (15 cm)	3,24	3,03	3,28	3,18
	Wide-row (45 cm)	3,20	3,14	3,38	3,24
	Wide-row (70 cm)	3,13	2,97	3,24	3,11

Table 3 – the Net productivity of crops of amaranth in dependence on the studied varieties and preparations of growth (g/m^2 /ha)

The mode of irrigation	Method sowing	Years of research			The average for the three years
		2015	2016	2017	
Vegetation watering at 60-65% the least moisture capacity	Private (15 cm)	1,44	1,36	1,52	1,44
	Wide-row (45 cm)	1,48	1,38	1,55	1,47
	Wide-row (70 cm)	1,40	1,36	1,51	1,42
Vegetation watering at 70-75% the least moisture capacity	Private (15 cm)	1,63	1,49	1,78	1,63
	Wide-row (45 cm)	1,60	1,55	1,81	1,65
	Wide-row (70 cm)	1,54	1,45	1,72	1,57
Vegetation watering at 80-85% the least moisture capacity	Private (15 cm)	1,77	1,51	1,86	1,71
	Wide-row (45 cm)	1,73	1,62	1,91	1,75
	Wide-row (70 cm)	1,62	1,50	1,80	1,64

Table 4 – Yield of amaranth depending on the studied irrigation regimes and method of sowing, t / ha (variety Kizlyarets)

The mode of irrigation	Method sowing	Years of research				Increase from irrigation	
		2015	2016	2017	average	tons/hectare	%
Vegetation watering at 60-65% the least moisture capacity	Private (15 cm)	27,8	27,0	28,4	27,7	-	100
	Wide-row (45 cm)	29,1	28,6	30,6	29,4		
	Wide-row (70 cm)	27,0	26,6	27,8	27,1		
Vegetation watering at 70-75% the least moisture capacity	Private (15 cm)	30,2	29,0	31,1	30,1	+2,1	+7,5
	Wide-row (45 cm)	31,5	30,6	32,6	31,6		
	Wide-row (70 cm)	28,9	28,4	29,7	29,0		
Vegetation watering at 80-85% the least moisture capacity	Private (15 cm)	31,4	30,8	32,6	31,6	+3,7	+13,1
	Wide-row (45 cm)	33,1	32,6	34,4	33,4		
	Wide-row (70 cm)	30,4	29,3	31,2	30,3		
LSD_{05}, tons/hectare		1,1	1,3	1,4			

Analysis of crop data, depending on the method of sowing, showed that the maximum yield was observed with a wide-row method of sowing (45 cm) in all variants under the irrigation regime. On the control (ordinary sowing, 15 cm) yield was 29.4 t/ha, respectively 6.1 above the control data (ordinary sowing, 15 cm) and 8.5 more data of the third option (wide-row sowing, 70 cm).

Increasing the humidity threshold to 70-75 % the least moisture capacity was accompanied by an increase in the yield of green mass of amaranth. In this case, higher productivity was also noted with a wide-row method of sowing (45 cm) – 31.6 t/ha. The Excess compared to the first option was 5.0%, and with the third option – 9.0%. A similar pattern on plots with pre-irrigation threshold moisture 80-85% the least moisture capacity. Increase in control (ordinary sowing, 15 cm) was 5.7%, and compared with the third (wide – row sowing, 70 cm) - 10.2 %.

The analysis of the amaranth yield during the research years showed that higher values were observed in the vegetation period of 2017, and the lowest – in 2016. Therefore, in the conditions of the Terek-Sulak subprovince of the Republic of Dagestan, higher productivity of the amaranth Kizlyarets variety is achieved with a wide-row method of sowing with spacing of 45 cm, with irrigation mode, providing for irrigation at pre-irrigation threshold of 80-85% the least moisture capacity.

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