THE EFFECT OF DIFFERENT SOWING SCHEMES AND FEEDING NORMS ON SOIL WATER PERMEABILITY IN AMARANTH CROPS SOWN FOR GREEN MASS

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Abstract. This article studies the effect of different sowing schemes and feeding rates on soil water permeability in amaranth (Amaranthus spp.) grown for green mass. The studies were conducted in 2023 at the end of the growing season in the 0–30 and 30–50 cm soil layers. Soil water permeability was determined for 6 hours, and the amount of water absorption was calculated for each hour. According to the results obtained, in all variants, the water absorption rate was high in the first hours and gradually decreased in the following hours. Planting schemes and feeding rates had a significant effect on soil water permeability. In particular, the water permeability in the 0–30 cm soil layer for a total of 6 hours was in the range of 797–879 units, and in the 30–50 cm layer it was 620–669 units. In the variants where relatively wider and optimal planting schemes are used, the soil permeability is high, which allows improving the water-air regime of the soil when growing amaranth for green mass. The results of the study are of scientific and practical importance in improving the agrotechnology of amaranth cultivation.

Keywords: amaranth, green mass, sowing scheme, feeding norms, soil water permeability, soil layers, water-air regime.

INTRODUCTION

Amaranthus cruentus is grown for its leaves and is a highly valued leafy vegetable in Nigeria due to its high nutritional and commercial value. Amaranthus cruentus contains vitamins such as β-carotene (a precursor of vitamin A), vitamin B6, vitamin C, riboflavin and folate, as well as nutritional minerals such as calcium, iron, magnesium, phosphorus, potassium, zinc, copper and manganese [1;147-154-p]. Amaranthus cruentus species are widely cultivated. Due to their early maturity and ability to survive in mixed cropping, they remain the most preferred crop for early income and survival by many farmers, while farmers wait for other crops to mature in

traditional natural mixed cropping systems. Amaranthus cruentus is grown in various cropping systems in home gardens, farms, inland valleys (fadams) and in peri-urban gardens [2; 289-293-p], [3; 29-35-p].

Amaranth is also known as amaranth, African spinach, bush greens, spinach greens, etc. Amaranths belong to the Amaranth family. There are many species and varieties of amaranths. Many hybrids are found among amaranths and are recognized as separate species. There are two types of amaranths, namely vegetable and grain amaranths [4; pp. 85–96].

Good growth and development of the amaranth plant directly depends on the properties of the soil and environmental conditions. At the same time, although the amaranth plant is not demanding on nutrients, it requires the presence of these substances in the minimum amount necessary for its development; if they are not enough, the plant growth process slows down or stops. Researchers note that the optimal ratio of nutrients in the soil should be 1:0.5:1.2 against nitrogen [5; pp. 10–12].

It has been noted that agrotechnical measures applied to amaranth plants have a significant impact on soil properties. In particular, the amount of mineral fertilizers and irrigation used for amaranth significantly increases the volume and mass of the soil [6; pp. 341–351, 7; pp. 18–12].

MATERIALS AND METHODS

Field experiments were conducted in 2023-2025 in the field of the TDAU experimental farm in the Kibray district of the Tashkent region under typical sierozem soil conditions. The experiment was conducted using the “Methodology of Field Experiments” by B.A.Dospekhov, the “Methods of Accounting and Mapping of Weed Vegetation” by A.M. Tulikov, and the “Methodology of Field Experiments” developed at the UZPITI. Field experiments were conducted in the Kibray district of the Tashkent region under sierozem soil conditions in 24 variants, 4 repetitions, and 4 tiers.

RESULTS AND DISCUSSION

Soil permeability is the ability of the soil to conduct water quickly and efficiently. The purpose of determining soil permeability is to understand the movement of water in the soil and its ability to store it, as well as to effectively irrigate plants and properly organize irrigation systems. By studying the water permeability of the soil, it is possible to determine the irrigation regime, ensure plant development, manage and increase soil fertility, and design irrigation systems, and properly construct drainage and irrigation

systems. When planting amaranth for green mass, the soil water permeability in each variant in the 0-30 and 30-50 cm layers at the 1st hour of determination in 2023 was determined as follows: in the 70x6-1 planting scheme, the $N_{250}P_{175}K_{125}$ fertilization rate was 308 in the 0-30 cm layer and 204 in the 30-50 cm layer; in the 70x9-1 planting scheme, the 0-30 cm layer was 307 and 209 in the 30-50 cm layer; in the 70x12-1 planting scheme, the 0-30 cm layer was 318 and 211 in the 30-50 cm layer; and in the 70x15-1 planting scheme, the 0-30 cm layer was 313 and 232 in the 30-50 cm layer. It was found that the fertilization rate of $N_{200}P_{140}K_{100}$ was 306 in the 0-30 cm layer and 203 in the 30-50 cm layer in the 70x6-1 planting scheme; 305 in the 0-30 cm layer and 207 in the 30-50 cm layer in the 70x9-1 planting scheme; 316 in the 0-30 cm layer and 209 in the 30-50 cm layer in the 70x12-1 planting scheme, and 311 in the 0-30 cm layer and 230 in the 30-50 cm layer in the 70x15-1 planting scheme. The fertilization rate of $N_{150}P_{105}K_{75}$ was 303 in the 0-30 cm layer and 200 in the 30-50 cm layer in the 70x6-1 planting scheme; In the 70x9-1 planting scheme, there were 302 in the 0-30 cm layer and 205 in the 30-50 cm layer; in the 70x12-1 planting scheme, there were 313 in the 0-30 cm layer and 207 in the 30-50 cm layer; and in the 70x15-1 planting scheme, there were 308 in the 0-30 cm layer and 228 in the 30-50 cm layer.

At the 2nd hour of soil permeability determination, it was determined that the $N_{250}P_{175}K_{125}$ fertilization rate was 199 in the 0-30 cm layer and 174 in the 30-50 cm layer in the 70x6-1 planting scheme; 199 in the 0-30 cm layer and 179 in the 30-50 cm layer in the 70x9-1 planting scheme; 179 in the 0-30 cm layer and 174 in the 30-50 cm layer in the 70x12-1 planting scheme, and 174 in the 0-30 cm layer and 170 in the 30-50 cm layer in the 70x15-1 planting scheme. It was found that the fertilization rate of $N_{200}P_{140}K_{100}$ was 198 in the 0-30 cm layer and 173 in the 30-50 cm layer in the 70x6-1 planting scheme; 198 in the 0-30 cm layer and 178 in the 30-50 cm layer in the 70x9-1 planting scheme; 178 in the 0-30 cm layer and 172 in the 30-50 cm layer in the 70x12-1 planting scheme, and 173 in the 0-30 cm layer and 169 in the 30-50 cm layer in the 70x15-1 planting scheme.

The fertilization rate of $N_{150}P_{105}K_{75}$ was 195 in the 0-30 cm layer and 171 in the 30-50 cm layer in the 70x6-1 planting scheme; It was found that in the 70x9-1 planting scheme, there were 195 in the 0-30 cm layer and 176 in the 30-50 cm layer; in the 70x12-1 planting scheme, there were 176 in the 0-30 cm layer and 174 in the 30-50 cm layer; and in the 70x15-1 planting scheme, there were 171 in the 0-30 cm layer and 168 in the 30-50 cm layer.

At the 3rd hour of soil permeability determination, it was determined that the $N_{250}P_{175}K_{125}$ fertilization rate was 146 in the 0-30 cm layer and 117 in the 30-50 cm layer in the 70x6-1 planting scheme; 189 in the 0-30 cm layer and 119 in the 30-50 cm layer in the 70x9-1 planting scheme; 154 in the 0-30 cm layer and 121 in the 30-50 cm layer in the 70x12-1 planting scheme, and 159 in the 0-30 cm layer and 118 in the 30-50 cm layer in the 70x15-1 planting scheme. It was found that the fertilization rate of $N_{200}P_{140}K_{100}$ was 145 in the 0-30 cm layer and 117 in the 30-50 cm layer in the 70x6-1 planting scheme; 188 in the 0-30 cm layer and 119 in the 30-50 cm layer in the 70x9-1 planting scheme; 153 in the 0-30 cm layer and 121 in the 30-50 cm layer in the 70x12-1 planting scheme, and 158 in the 0-30 cm layer and 118 in the 30-50 cm layer in the 70x15-1 planting scheme. The fertilization rate of $N_{150}P_{105}K_{75}$ was 144 in the 0-30 cm layer and 115 in the 30-50 cm layer in the 70x6-1 planting scheme; In the 70x9-1 planting scheme, it was found that there were 186 in the 0-30 cm layer and 117 in the 30-50 cm layer; in the 70x12-1 planting scheme, there were 151 in the 0-30 cm layer and 119 in the 30-50 cm layer; and in the 70x15-1 planting scheme, there were 156 in the 0-30 cm layer and 116 in the 30-50 cm layer.

At the 4th hour of soil permeability determination, it was determined that the $N_{250}P_{175}K_{125}$ fertilization rate was 95 in the 0-30 cm layer and 83 in the 30-50 cm layer in the 70x6-1 planting scheme; 104 in the 0-30 cm layer and 90 in the 30-50 cm layer in the 70x9-1 planting scheme; 106 in the 0-30 cm layer and 95 in the 30-50 cm layer in the 70x12-1 planting scheme, and 109 in the 0-30 cm layer and 81 in the 30-50 cm layer in the 70x15-1 planting scheme. It was found that the fertilization rate of $N_{200}P_{140}K_{100}$ was 94 in the 0-30 cm layer and 82 in the 30-50 cm layer in the 70x6-1 planting scheme; 104 in the 0-30 cm layer and 89 in the 30-50 cm layer in the 70x9-1 planting scheme; 106 in the 0-30 cm layer and 94 in the 30-50 cm layer in the 70x12-1 planting scheme, and 109 in the 0-30 cm layer and 80 in the 30-50 cm layer in the 70x15-1 planting scheme. The fertilization rate of $N_{150}P_{105}K_{75}$ was 93 in the 0-30 cm layer and 81 in the 30-50 cm layer in the 70x6-1 planting scheme; In the 70x9-1 planting scheme, it was found that there were 103 in the 0-30 cm layer and 88 in the 30-50 cm layer; in the 70x12-1 planting scheme, there were 105 in the 0-30 cm layer and 93 in the 30-50 cm layer; and in the 70x15-1 planting scheme, there were 107 in the 0-30 cm layer and 79 in the 30-50 cm layer.

At the 5th hour of soil permeability determination, it was determined that the $N_{250}P_{175}K_{125}$ fertilization rate was 39 in the 0-30 cm layer and 33 in the 30-50 cm layer in the 70x6-1 planting scheme; 45 in the 0-30 cm layer and 35 in the 30-50 cm layer in

the 70x9-1 planting scheme; 48 in the 0-30 cm layer and 37 in the 30-50 cm layer in the 70x12-1 planting scheme, and 35 in the 0-30 cm layer and 35 in the 30-50 cm layer in the 70x15-1 planting scheme. It was found that the fertilization rate of $N_{200}P_{140}K_{100}$ was 39 in the 0-30 cm layer and 33 in the 30-50 cm layer in the 70x6-1 planting scheme; 44 in the 0-30 cm layer and 35 in the 30-50 cm layer in the 70x9-1 planting scheme; 47 in the 0-30 cm layer and 37 in the 30-50 cm layer in the 70x12-1 planting scheme, and 35 in the 0-30 cm layer and 35 in the 30-50 cm layer in the 70x15-1 planting scheme. The fertilization rate of $N_{150}P_{105}K_{75}$ was 38 in the 0-30 cm layer and 32 in the 30-50 cm layer in the 70x6-1 planting scheme; It was found that in the 70x9-1 planting scheme, there were 44 in the 0-30 cm layer and 34 in the 30-50 cm layer; in the 70x12-1 planting scheme, there were 47 in the 0-30 cm layer and 36 in the 30-50 cm layer; and in the 70x15-1 planting scheme, there were 34 in the 0-30 cm layer and 34 in the 30-50 cm layer.

At the 6th hour of soil permeability determination, it was determined that the $N_{250}P_{175}K_{125}$ fertilization rate was 25 in the 0-30 cm layer and 22 in the 30-50 cm layer in the 70x6-1 planting scheme; 35 in the 0-30 cm layer and 25 in the 30-50 cm layer in the 70x9-1 planting scheme; 37 in the 0-30 cm layer and 27 in the 30-50 cm layer in the 70x12-1 planting scheme, and 40 in the 0-30 cm layer and 33 in the 30-50 cm layer in the 70x15-1 planting scheme. It was found that the fertilization rate of $N_{200}P_{140}K_{100}$ was 25 in the 0-30 cm layer and 22 in the 30-50 cm layer in the 70x6-1 planting scheme; 35 in the 0-30 cm layer and 25 in the 30-50 cm layer in the 70x9-1 planting scheme; 37 in the 0-30 cm layer and 27 in the 30-50 cm layer in the 70x12-1 planting scheme, and 40 in the 0-30 cm layer and 33 in the 30-50 cm layer in the 70x15-1 planting scheme. The fertilization rate of $N_{150}P_{105}K_{75}$ was 24 in the 0-30 cm layer and 21 in the 30-50 cm layer in the 70x6-1 planting scheme; In the 70x9-1 planting scheme, it was found that there were 34 in the 0-30 cm layer and 24 in the 30-50 cm layer; in the 70x12-1 planting scheme, it was found that there were 36 in the 0-30 cm layer and 26 in the 30-50 cm layer; and in the 70x15-1 planting scheme, it was found that there were 39 in the 0-30 cm layer and 32 in the 30-50 cm layer.

Table 1
The effect of sowing schemes and feeding rates on soil permeability in an amaranth field sown for green mass (end of the vegetation period), 2023

№	Sowing schemes	Fertilizers rates, kg/ha	dates and rates of foliar application	Soil layers	Detection hours						Total in 6 hours
					1	2	3	4	5	6	
1	70x6-1	$N_{250}P_{175}K_{125}$	Control (treated with water)	0-30	308	199	146	95	39	25	812
				30-50	204	174	117	83	33	22	633
2	70x9-1			0-30	307	199	189	104	45	35	879
				30-50	209	179	119	90	35	25	657
3	70x12-1			0-30	318	179	154	106	48	37	842
				30-50	211	174	121	95	37	27	665
4	70x15-1			0-30	313	174	159	109	35	40	830
				30-50	232	170	118	81	35	33	669
5	70x6-1	$N_{200}P_{140}K_{100}$	Aquarin-14 (NPK 20-20-20) water-soluble complex fertilizer at a rate of 1.4 kg/ha during the 5-6 leaf stage and 1.8 kg/ha during the panicle formation stage	0-30	306	198	145	94	39	25	807
				30-50	203	173	117	82	33	22	630
6	70x9-1			0-30	305	198	188	104	44	35	874
				30-50	207	178	119	89	35	25	653
7	70x12-1			0-30	316	178	153	106	47	37	837
				30-50	209	172	121	94	37	27	660
8	70x15-1			0-30	311	173	158	109	35	40	826
				30-50	230	169	118	80	35	33	665
9	70x6-1	$N_{150}P_{105}K_{75}$	Aquarin-14 (NPK 20-20-20) water-soluble complex fertilizer at 1.2 kg/ha in the 4-5 leaf stage, 1.5 kg/ha in the 8-9 leaf stage, and 1.8 kg/ha during the panicle formation stage.	0-30	303	195	144	93	38	24	797
				30-50	200	171	115	81	32	21	620
10	70x9-1			0-30	302	195	186	103	44	34	864
				30-50	205	176	117	88	34	24	644
11	70x12-1			0-30	313	176	151	105	47	36	828
				30-50	207	174	119	93	36	26	655
12	70x15-1			0-30	308	171	156	107	34	39	815
				30-50	228	168	116	79	34	32	657

When the soil water permeability index was determined and studied for 6 hours when amaranth was planted for green mass, the total $N_{250}P_{175}K_{125}$ fertilization rate was 812 in the 0-30 cm layer and 633 in the 30-50 cm layer in the 70x6-1 planting scheme; In the 70x9-1 planting scheme, it was found that there were 879 in the 0-30 cm layer and 657 in the 30-50 cm layer; in the 70x12-1 planting scheme, it was found that there were 842 in the 0-30 cm layer and 665 in the 30-50 cm layer, and in the 70x15-1 planting scheme, it was found that there were 830 in the 0-30 cm layer and 669 in the 30-50 cm layer. In the 70x6-1 planting scheme, the fertilization rate of $N_{200}P_{140}K_{100}$ was 807 in the 0-30 cm layer and 630 in the 30-50 cm layer; in the 70x9-1 planting scheme, it was found that there were 874 in the 0-30 cm layer and 653 in the 30-50 cm layer; It was found that in the 70x12-1 planting scheme, the 0-30 cm layer was 837 and in the 30-50 cm layer was 660, and in the 70x15-1 planting scheme, the 0-30 cm layer was 826 and in the 30-50 cm layer was 665. In the 70x6-1 planting scheme, the $N_{150}P_{105}K_{75}$ fertilization rate was 797 and in the 30-50 cm layer was 620; in the 70x9-1 planting scheme, the 0-30 cm layer was 864 and in the 30-50 cm layer was 644; It was found that in the 70x12-1 planting scheme, there were 828 in the 0-30 cm layer and 655 in the

30-50 cm layer, and in the 70x15-1 planting scheme, there were 815 in the 0-30 cm layer and 657 in the 30-50 cm layer.

CONCLUSION

The results of the study showed that planting schemes and feeding rates have a significant impact on soil water permeability in the field of amaranth grown for green mass. In wider planting schemes, especially in the 70×9–1 and 70×12–1 variants, the amount of water absorption in the 0–30 and 30–50 cm soil layers was higher. It was found that the water-air regime improved when using average rates of mineral fertilizers and foliar feeding with Aquarin-14. The results obtained serve as a scientific basis for choosing optimal agrotechnologies for growing amaranth for green mass.

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