Original Article

NUTRIENT INTAKE BY COTTON

Sotvoldi Tursunov

Professor of Namangan Institute of Engineering and Technology, Namangan city, Republic of Uzbekistan.
E-mail: sotvolditursunov@mail.ru

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Abstract

The article developed methods for increasing the yield of cotton by applying the optimal density of standing and the level of nutrition in the conditions of meadow soils of the Ferghana Valley. The growth and development of cotton on wide-row crops were studied, depending on the plant density and the level of mineral nutrition.

Keywords: cotton yield, cotton stand density, cotton nutrition level, mineral fertilizers.

Introduction

K.A. Timiryazev (1949) wrote that the provision of crops is possible primarily with knowledge of the needs of plants and the ability to satisfy them with nutrients. The content of nutrients in a plant is greatly influenced by soil fertility and fertilizers, the consumption of which depends on varietal characteristics, plant density and other factors.

The results of the research found that the content of nitrogen, phosphorus and potassium in the organs of cotton at the end of the growing season depends on the removal of nutrients, which in its turn depends on the norms of fertilizers, manure application and the density of standing plants. Cotton grown with fertilizers contains significantly more of these elements compared to plants grown without fertilizers. According to our data, the application of fertilizers increased the amount of NPK in all organs of cotton (Table 1).

So, when cultivating cotton without fertilizers and the density of 90 thousand / ha of nitrogen in the leaves was 2,80, in the stems – 0,79, in the sashes 1.86 and in the seeds – 2,10%, when using N-250 P_2O_5-150 K_2O-100, the nitrogen content increased respectively by 0,2%, 0,08%, 0,11% and 0,25%. An increase in the fertilizer rate to N-350 P_2O_5-210 K_2O-150 led to an increase in nitrogen intake in cotton: as a result, the amount of this element increased in leaves by 0,32, stems – 0,15, sashes – 0,87 and seeds by 0,70%, compared with cotton cultivated without fertilizers. The introduction of N-450 P_2O_5-270 K_2O-200 inhibited the entry of NPK into plants and, compared with N-350 P_2O_5-210 K_2O-150, reduced the number of these elements in the organs of cotton.

Table 1 The content of nutrients in the organs of cotton at the end of the growing season, % on dry matter

Option number	The density of standing plants, thousand / ha														
	90					120					150				
	leaves	stems	sashes	seeds	fiber	leaves	stems	sashes	seeds	fiber	leaves	stems	sashes	seeds	fiber
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Nitrogen															
1	2,80	0,79	1,86	2,10	0,35	3,09	0,98	1,46	1,86	0,30	3,05	1,09	0,83	1,90	0,30
2	3,00	0,87	1,99	2,35	0,40	3,18	1,17	1,70	1,98	0,35	3,28	1,130	1,34	2,02	0,32
3	3,11	0,94	2,04	2,57	0,42	3,24	1,23	1,83	2,14	0,38	3,43	1,37	1,40	2,10	0,35
4	3,12	1,10	2,73	2,77	0,43	3,90	1,32	1,77	2,43	0,40	3,71	1,58	2,09	2,25	0,36
5	3,18	1,27	2,82	2,80	0,44	3,89	1,40	2,49	2,63	0,41	4,18	1,54	2,26	2,37	0,38
6	3,05	1,05	2,35	2,53	0,40	3,58	1,24	2,07	2,37	0,35	3,65	1,31	1,57	2,24	0,35
7	2,97	1,02	2,60	2,64	0,41	3,73	1,32	2,17	2,41	0,36	3,46	1,45	1,66	2,33	0,36
Phosphorus															
1	0,47	0,253	0,305	0,790	0,103	0,445	0,242	0,305	0,620	0,090	0,490	0,239	0,275	0,480	0,070
2	0,50	0,290	0,340	0,860	0,105	0,487	0,281	0,335	0,740	0,100	0,505	0,336	0,324	0,510	0,080
3	0,52	0,390	0,416	0,890	0,105	0,514	0,298	0,378	0,790	0,105	0,561	0,332	0,343	0,620	0,090
4	0,544	0,427	0,486	0,960	0,106	0,542	0,327	0,430	0,910	0,105	0,613	0,380	0,416	0,810	0,090
5	0,62	0,433	0,544	0,970	0,106	0,567	0,417	0,478	1,000	0,106	0,623	0,393	0,449	0,930	0,100
6	0,52	0,397	0,427	0,830	0,107	0,500	0,295	0,405	0,880	0,105	0,568	0,359	0,418	0,830	0,095
7	0,51	0,396	0,445	0,900	0,107	0,527	0,298	0,415	0,970	0,105	0,568	0,374	0,435	0,860	0,095
Potassium															
1	1,50	0,97	3,71	1,02	0,580	1,27	1,01	3,52	1,00	0,580	1,54	1,13	3,30	0,90	0,585
2	1,68	1,20	3,90	1,08	0,650	1,57	1,20	3,90	1,00	0,640	2,02	1,24	3,64	1,05	0,630
3	1,80	1,54	4,38	1,10	0,655	1,91	1,35	4,01	1,05	0,650	2,10	1,39	3,90	1,00	0,650
4	2,25	1,58	4,65	1,17	0,660	2,16	1,35	4,65	1,05	0,650	2,55	1,73	4,27	1,02	0,655
5	2,10	1,73	4,87	1,25	0,670	2,40	1,65	4,64	1,10	0,660	2,55	1,80	4,42	1,10	0,660
6	1,72	1,18	4,20	1,07	0,660	1,84	1,13	4,10	1,00	0,640	2,25	1,29	4,18	1,00	0,660
7	1,84	1,24	3,93	1,10	0,660	1,91	1,20	4,27	1,02	0,640	2,36	1,31	4,27	1,05	0,660

The use of manure stimulated the assimilation of nutrients by cotton. The fiber has the smallest amount of nitrogen when cultivating cotton without fertilizers – 0,40 – 0,44%.

Literary Review

In cotton seeds grown without fertilizers, the content of phosphorus was 0,790%, and from 0,860 to 0,970% in seeds from fertilized variants. Moreover, as well as nitrogen, the content of phosphorus in seeds rose with an increase in the rate of fertilizers (up to N-350 P_2O_5-210 K_2O-150). This was a positive factor, since it is known that a good supply of phosphorus to cotton accelerates the ripening of bolls and reduces the percentage of post-frost harvest (Belousov, 1964; Yuldashev, Nazarov, 1976; Pirakhunov, 1977; Sattarov, 1982; Rakhmatdzhanov, Khokhlov, Khaitova, 1985, etc.).

Phosphorus is a part of all organs of cotton, but in a smaller amount compared to nitrogen and potassium. Table 1 shows that at a density of 90 thousand/ha of plants, the content of phosphorus in the organs of cotton fluctuated and depended on the background of nutrition: for example, in leaves from 0,47 to 0,62%, in stems - from 0,253 to 0,433%, in sashes - from 0,305 up to 0,544% and fiber - from 0,103 to 0,107%. The effect of fertilizers on the entry of phosphorus into the organs of cotton was similar to that of nitrogen.

At the end of the cotton growing season potassium is concentrated in the sashes. At the same time, in plants grown without fertilizers, potassium in the sashes was 3,71%, while with fertilizers: N-250 P_2O_5-150 K_2O-100 – 3,90% and N-350 P_2O_5-210 K_2O-150 it was – 4,65%. The use of manure together with mineral fertilizers stimulated the flow of potassium into the plants. According to the potassium content, the cotton organs are arranged in the following descending order: sashes, leaves, stems, seeds, fiber.

It should be noted that the norms of fertilizers N-450 P_2O_5-270 K_2O-200 had a negative effect on the content and consumption of PK by cotton.

The results of studies on the effect of plant density on the content of nutrients in the organs of cotton revealed the great importance of this factor.

With an increase in the density of cotton standing (120-150 thousand/ha), the nitrogen content in seeds, fiber and sashes is less compared to plants grown at a density of 90 thousand/ha.

With a standing density of 120-150 thousand / ha, cotton has a more powerful vegetative mass and nitrogen reutilization from the leaves and stems of these plants weakens somewhat, which increases the nitrogen content in them. It should be noted that on thickened crops, seeds suffer especially severely, since their nutrients are depleted.

Along with the study of the chemical composition in the organs of cotton, the consumption of nutrients is also of interest, which makes it possible to determine the compensation of their removal by fertilizers, as well as the direction of the use of soil fertility.

Having the value of the dry mass and the chemical composition of its individual parts, it is possible to determine the removal of nutrients by cotton. It has been established that the consumption of nutrients by cotton varies widely depending on the productivity of the biological mass and the proportion of raw cotton in it. The greatest removal of nitrogen, phosphorus and potassium is possible with a strong growth of the vegetative mass, when raw cotton makes up only 25-30% of the total plant mass. Such a development with a predominance of the vegetative mass of the plant is possible with excessive nutrition or an incorrect ratio of nutrients in the nutrient mixture.

The consumption of nutrients under the conditions of our experiment is presented in Table 2. According to the data obtained, the removal of nitrogen and potassium by the main (harvest) and side (vegetative mass) products increased with the thickening of cotton crops. This was due to an increase in the removal of these elements by the vegetative mass. So, in the variant without fertilization at a plant density of 90 thousand/ha, cotton carried out nitrogen – 143,1, phosphorus – 35,4 and potassium 127,5 kg, at 120 thousand/ha - respectively 168,0, 34,8 and

179,6 kg/ha and at a density of 150 thousand/ha – 157,6, 34,8 and 197,4 kg/ha. At the same time, the share of PK removal by side products increased and decreased by the main product.

The ratio of the removal of the vegetative mass to the reproductive mass at a density of 90 thousand/ha of plants in the variant without fertilizers was 2,8 for nitrogen, phosphorus – 1,6 and potassium - 5. The use of fertilizers increased the removal of both side and main products. However, the ratio of the removal of by-products to the main one narrowed somewhat: for nitrogen, from 2,6 to 2,1, for phosphorus, from 1,4 to 1,5, and for potassium, from 4,8 to 5,4. This indicates that the application of fertilizers contributed to an increase in yield, and hence the carryover, which led to a narrowing of this ratio. It was the narrowest for nitrogen (2,1), potassium 4,8 and phosphorus (1,5) at a fertilizer rate of N-350 P_2O_5-210 K_2O-150 + 30 tons of manure.

The introduction of N-450 P_2O_5-270 K_2O-200 had a negative effect on the removal of NPK and expanded the ratio of vegetative to reproductive mass.

Table 2 PK consumption by cotton at the end of the growing season, kg/ha

Option number	Plant density, thousand/ha											
	90				120				150			
	Taken out, kg/ha			The ratio of vegetative mass removal to reproduction	Taken out, kg/ha			The ratio of vegetative mass removal to reproduction	Taken out, kg/ha			The ratio of vegetative mass removal to reproduction
	Vegetative mass	The harvest of raw cotton	In total		Vegetative mass	The harvest of raw cotton	In total		Vegetative mass	The harvest of raw cotton	In total	
1	2	3	4	5	6	7	8	9	10	11	12	13
Nitrogen												
1	106,0	37,1	143,1	2,8	136,6	31,4	168,0	4,3	129,0	28,6	157,6	4,5
2	142,3	57,6	199,9	2,5	195,2	47,6	242,8	4,1	204,1	45,7	249,8	4,5
3	159,2	74,9	234,1	2,1	242,8	59,5	302,3	4,1	231,4	53,0	284,4	4,4
4	188,4	83,8	272,2	2,2	249,6	68,7	318,3	3,6	300,9	58,7	359,6	5,1
5	208,7	97,0	305,7	2,1	290,0	85,0	375,0	3,4	351,6	65,9	417,5	5,3
6	188,7	73,0	261,7	2,6	263,0	65,7	328,7	4,0	289,4	58,3	347,7	5,0
7	198,2	77,9	276,1	2,5	290,1	68,9	359,0	4,2	310,6	61,1	371,7	5,1
Phosphorus												
1	22,0	13,4	35,4	1,6	24,4	10,4	34,8	2,3	27,6	7,2	34,8	3,8
2	29,1	20,6	49,7	1,4	33,6	17,4	51,0	1,9	39,5	11,5	51,0	3,4
3	37,7	25,7	63,4	1,5	39,4	21,5	60,9	1,8	45,4	15,5	60,9	3,0
4	43,1	28,4	71,5	1,5	52,8	27,1	79,9	1,9	59,2	20,7	79,9	2,8

5	49,2	33,0	82,2	1,5	58,9	32,6	91,5	1,8	67,2	25,3	92,5	2,6
6	43,5	23,7	67,2	1,8	47,1	24,1	71,2	1,9	61,7	21,2	82,9	2,9
7	45,6	26,2	71,8	1,7	51,0	27,3	78,3	1,8	66,8	22,8	89,6	2,9
Potassium												
1	106,2	21,3	127,5	5,0	159,3	20,3	179,6	7,8	180,7	16,7	197,4	10,8
2	162,5	32,0	194,5	5,1	226,3	29,2	255,5	7,7	259,4	28,6	288,0	9,1
3	196,5	38,2	234,7	5,1	248,0	35,1	283,1	7,1	301,6	31,0	332,6	9,7
4	225,7	41,8	267,5	5,4	293,0	35,8	328,8	8,2	369,9	32,5	402,4	11,4
5	242,9	50,7	293,6	4,8	318,7	42,4	361,1	7,5	413,8	36,8	450,6	11,2
6	186,2	37,3	223,5	5,0	254,7	33,8	288,5	7,5	341,5	32,1	373,6	10,6
7	196,7	38,7	235,4	5,1	278,4	35,3	313,7	7,9	368,9	33,7	402,6	10,9

Nitrogen removal was very close to potassium removal and exceeded phosphorus alienation by almost 4 times. An increase in the density of standing plants to 150 thousand / ha, approximately 2 times expanded the ratio of vegetative mass removal to reproductive. Thus, it was found that on the old-irrigated meadow soils of the gray-earth belt with a low content of nutrients for cotton of the 175-f variety, the optimal plant density is 90 thousand / ha and fertilizer norms N-350 P_2O_5-210 K_2O-150 against the background of manure.

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