3.6. Soil salt regime and soil absorption complex composition changes

The main aspects under drainage water reuse on irrigation are as follow: salt restoration preventing, salt regime stability control and soil solution in root zone keeping within the acceptable values.

Field investigations results show, that on the pilot plots salt soil regime fluctuated depending on used water salinity and water-salt balance tendency, drainability of the territory, etc. Influence of ditch and drainage waters on soil salts content are shown in table 3.9. Duration of investigations is from 3 to 15 years.

Data show, that on light and medium loamy soils under leaching regime and negative water-salt balance, drainage water salinity of 2-4 g/l use in annual cycle does not influence adversely and salts content in top soil layers is not higher than in control variant. In annual and long-term cycle negative balance with salt removal from 5 to 20 t/ha leads to soils gradual desalinization.

For example, investigations in Fergana valley (the pilot plots 0.3.3; 03.4; 03.5 Uzbekistan), where on strongly saline lands (salt sum from 1,0 to 2,4%) leaching irrigation regime on background of well operated drainage was kept, multi-year irrigation by drainage water with concentration from 2 to 4,4 g/l does did not lead to salt accumulation, but, on the contrary, led to desalinization on 0,3-0,9% on dry residue. Over above sites under ditch water irrigation (0,6-1,0 g/l) on control variant, soils desalinization was intensive, but ultimately, high desalinization rate was not observed because during vegetation period in control variant water-salt balance sometimes was positive.

In conditions of Turkmenistan on non-saline sandy soils irrigation by drainage water with salinity 2,1-2,8 g/l did not influence soil salts content, and latter was stable as in experiment so in control under ditch water irrigation (Mop=0,5-0,6 g/l).

In conditions of South-Kazakhstan on slightly saline soils ground water use for irrigation did not influence negatively. Only on rice field more intensive desalinization was observed (table 3.9).
At the same time, drainage water with high salinity up to 7,0 g/l use under invariable water supply and the same irrigation regime in Hungry Steppe has led to positive balance with salt accumulation to 25 t/ha and its content to the end of investigations increased from 0,380 to 1,000% on dry residue (Plot 03,7 Uzb).

Soil desalinization with salt soluble sum increase to permissible limits 0,3-0,5% and on ion-chlorine lower than 0,015% was occurred in the most part of the pilot plots.
In seasonal regime under drainage water use for irrigation certain salts accumulation in top thickness occurred during vegetation (spring-autumn). Similar regime was observed over site of Hungry Steppe (Uzbekistan), which is shown on graph, fig. 3.5. for various variants of drainage water use. This insignificant salts accumulation was eliminated by means of autumn-winter leaching.

Physical-chemical soils content and soil absorption complex changes

The main question under drainage water reuse for irrigation and fields leaching is study of its influence on exchange reaction of soil absorption complex.

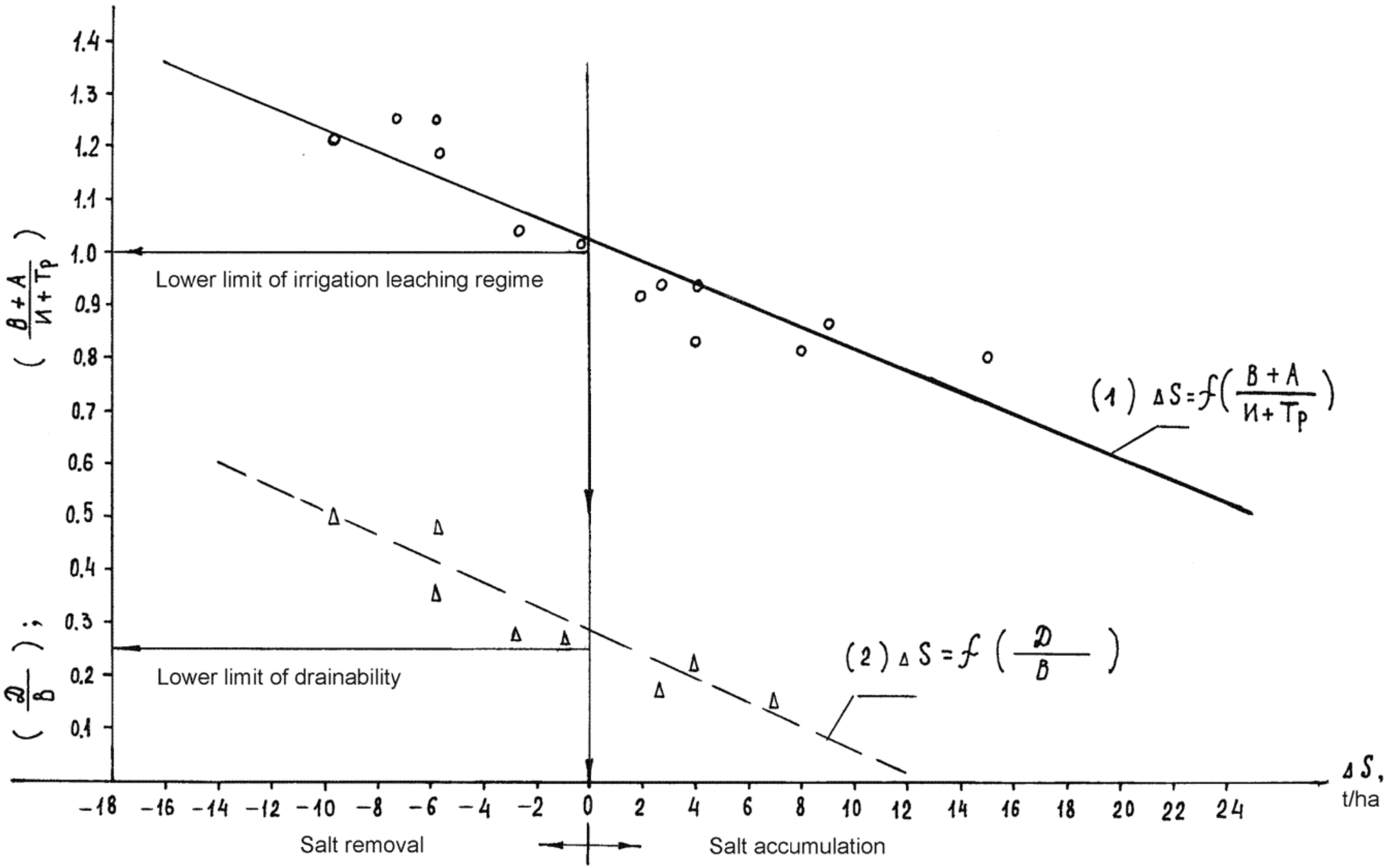
Table 3.9

Drainage water utilization impact on soil salinity and absorbing complex composition

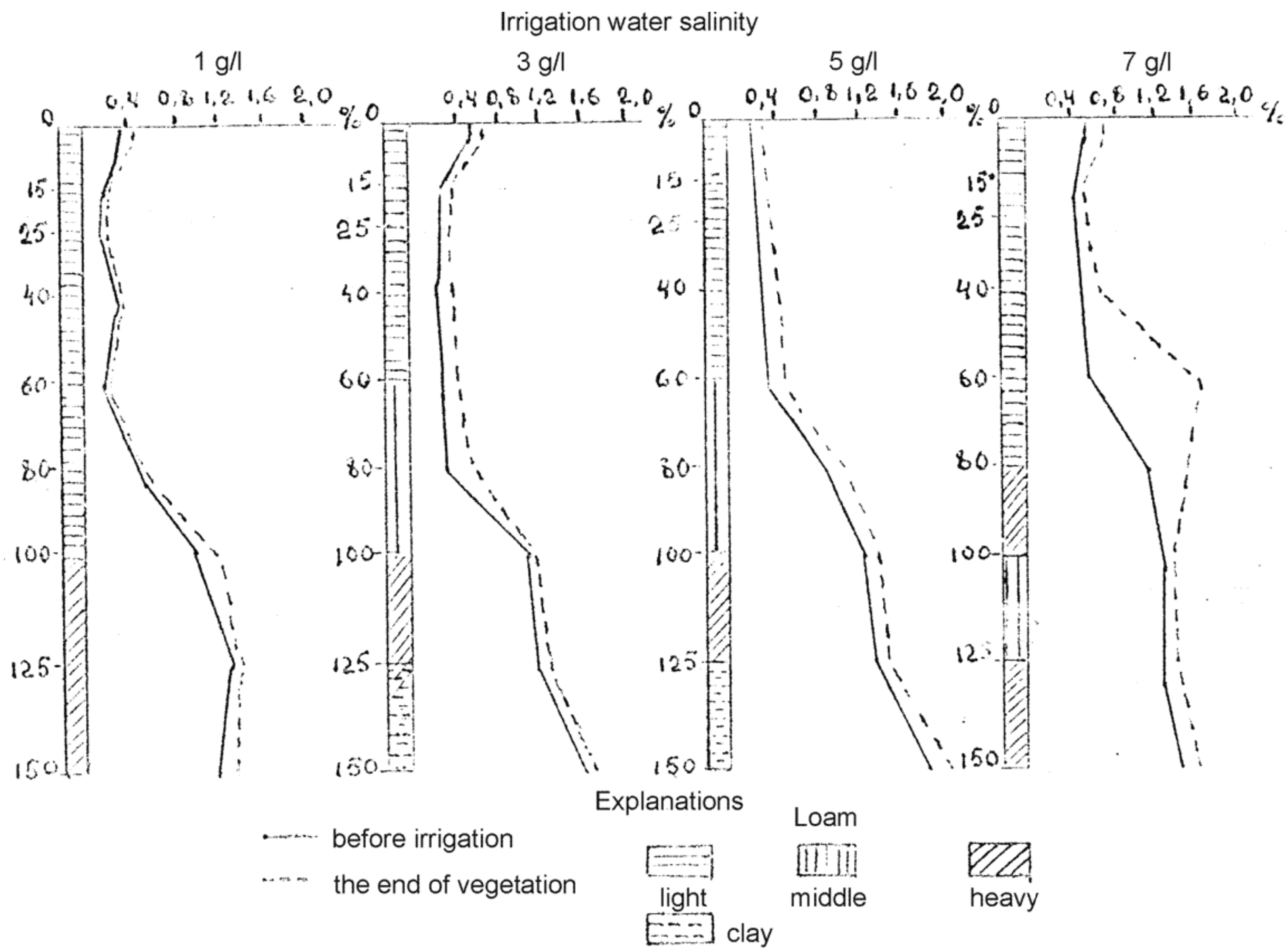
Plot index	Soil type with regard for mechanical composition	Data type or versions	Salinity, g/l	Salt difference according to balance (±) t/ha	Result, initial/ achieved	Dry residue in soil, % of mass	Dynamics of soil-absorbing complex (SAC)			
							Sum of SAC, mg-ekv 100 g of soil	Exchangable Ca^{++}, % of SAC	Exchangable Na^{+}, % of SAC	Signs of sodification
Uzbekistan										
03.1.Uz.	loam	experiment	2,0-16,0	-	initial	0,3-1,2	not defined	not defined	5-10	not found
					achieved	0,5-1,2			5-10	
		control	0,2	-	initial	non-saline	not defined	not defined	1,5	not found
					achieved	non-saline			1,5	
03.2.Uz.	middle and heavy loam	experiment	2,0-5,6	-	initial	0,3	5,7	58	10,2	not found
					achieved	0,3	6,3	59	10,2	
		control	0,6-1,0	-	initial	0,3	5,7	58	10,2	not found
					achieved	0,3	6,3	59	10,2	
03.3.Uz.	sand, loam, sandy loam	experiment	2,1-3,10	-9,7	initial	1,5-2,34	7,0	51	0,71	not found
					achieved	0,3-0,9	6,8	55	2,8	
		control	0,4-0,6	-21,0	initial	1,5-2,34	3,3	61	2,0	not found
					achieved	0,3-0,9	6,9	68	2,3	
03.4.Uz..	light, middle loam	experiment	0,8-2,0	-5,7-	initial	0,3-1,0	6,7	61	0,31	not found
					achieved	0,3-0,8	11,3	67	1,9	
		control	0,4-1,0	-10	initial	0,3-1,0	6,6	61	1,1	not found
					achieved	0,3-08	7,9	70	1,8	
03.5.Uz.	light, middle loam	experiment	2,2-4,4	-5-9-	initial	1,3-2,4	6,16	49,2	5,05	not found
					achieved	0,7-1,0	8,9	61,0	5,5	
		control	0,5-0,9	-20	initial	1,3-2,4	3,8	46,0	5,7	not

Plot index	Soil type with regard for mechanical composition	Data type or versions	Salinity, g/l	Salt difference according to balance (±) t/ha	Result, initial/ achieved	Dry residue in soil, % of mass	Dynamics of soil-absorbing complex (SAC)			
							Sum of SAC, mg-ekv 100 g of soil	Exchangable Ca^{++}, % of SAC	Exchangable Na^{+}, % of SAC	Signs of sodification
					achieved	0,5-0,9	9,9	70,0	4,9	found
03.6.Uz.	TESTS ON DRAINAGE WATER BIOLOGICAL TREATMENT									
03.7.Uz.	middle	experiment	7,0	+25	initial	0,380	not defined			-
					achieved	1,000				
	loam	experiment		-	initial	0,500	not defined			-
					achieved	0,500				
		control			initial	0,470	not defined			-
					achieved	0,420				
Turkmenistan										
03.1.Tur.	light loam	experiment	2-1-2,8	-	initial	0,450	6,08	71,8	4,52	not found
					achieved	0,460	6,25	69,8	3,3	
		control	0,5-0,6	-	initial	0,330	6,08	71,8	4,52	not found
					achieved	0,350	7,06	70,4	1,52	
03.2.Tur.	heavy loam	experiment	2-3	-	initial	0,150	not defined			-
					achieved	0,150				
		control			initial	0,150	not defined			-
					achieved	0,150				
Kazakhstan										
03.1.Kaz.	middle and heavy loam	experiment	0,7-2,0	-2,7	initial	0,06-0,232	10,9-27,1	40-76	1,8-10,9	not found
					achieved	0,06-0,332	10,9-27,1	40-76	1,8-10,9	
		control	0,7-1,0	-4,7	initial	0,06-0,232	10,9-27,1	40-76	1,8-10,9	not

Plot index	Soil type with regard for mechanical composition	Data type or versions	Salinity, g/l	Salt difference according to balance (±) t/ha	Result, initial/ achieved	Dry residue in soil, % of mass	Dynamics of soil-absorbing complex (SAC)			
							Sum of SAC, mg-ekv 100 g of soil	Exchangable Ca^{++}, % of SAC	Exchangable Na^{+}, % of SAC	Signs of sodification
					achieved	0,06-0,230	10,9-27,1	40-76	1,8-10,9	found
03.2.Kaz.	loam clay	experiment	2,6-3,0	-	initial	0,380	not defined		12-18	not found
		control	1,0-1,4	-	achieved	0,330			12-18	
03.3.Kaz.	loam clay	control	1,0-1,4	-	initial	0,350	not defined		4-7	not found
					achieved	0,06			4-7	
Kyrgyz Republic										
03.1 Kyr.	middle loam	experiment	1,8-2,2	+2,7	initial	0,170	9,60	58	5,8	sodification
					achieved	0,190	9,90	60	6,4	
		control	0,4-0,5	-2,4	initial	0,170	not defined			sodification
					achieved	0,190				



Dr.3.4. Salt stock change within balance layer depending on irrigation leaching regime coefficient (1) and area drainability (2).



Dr. 3.5. Pilot plot in statefarm No. 7 sail salinity changes under irrigation by saline water (spring-autumn 1976).

Character of capacity and soil absorption complex (SAC) changes over the pilot plots is shown in table 3.9.

Generalization results show, that in conditions of Central Asia on the majority of sites soils and drainage water are saturated with carbonate and calcium salts (gypsum) and its reuse almost does not influence exchangeable cation composition. Under drainage water reuse with similar composition on slightly and medium saline soils under leaching regime kept absorbed bases composition improvement occurred, i.e. physical-chemical soils quality increased under cation Ca^{++} applied and Na^{+} forced out.

Data of table 3.10 show, that in most of the pilot plots during long-term drainage water reuse SAC almost has not changed - Ca^{++} cation content was from 45 to 76%, and harmful Na^{+} fluctuated from 0,3 to 5% of SAC sum. Only insignificant cation re-distribution and absorption capacity change very slowly.

In separate cases high initial absorbed Na^{+} content was up to 15-18% of SAC sum, but during drainage water use for irrigation its content was stable as in experiment so in control variant with ditch water use (table 3.9, pilot 03.2).

In the same time in Chu valley (Kyrgyzstan) in conditions of alkali soils and drainage waters pH exceeding 8.5, where magnesium sulfate, sodium and even soda prevailed in water content, the risk of soil sodification is found. During investigations insignificant absorbed Na^{1} content from 5,8 to 6,4% and C^{11} from 58 to 60% of SAC sum increased As soda is available, authors suggest it is necessary to apply gypsum for neutralization of sodification.

It worth to note, that any physical signs of soils sodification are not found in other experiments. It is obvious, that on soils poor with humus and low exchangeable capacity its ability to ion-exchange sorption is not high, and following agrotechnical measures and keeping leaching regime and good drainability, availability in water and soil of gypsum and calcium irrigations by drainage water with low salinity do not aggravate SAC content, soil quality and its fertility.