REGISTER OF RESEARCH ON IRRIGATION AND DRAINAGE

QUESTIONNAIRE

A	**Project title:**
Efficiency of the Drip Irrigation with Vertical Drainage	

B	**Topic n^{o} : 1**	Sub-topic n^{o}: 3
1)	1	Technical field n^{o}: 1
2)	Category n^{o}: 01	

C	**Project location**		
	Country: Republic of Kazakhstan	Area: 500 ha	
South-Kazakhstan province; Turkestan district, «Ikan» cotton state farm			

D	**Duration of the project:**		
	Year in which the project was started: 1992	Project completed:	1995
		Dates of Expertise:	1995

E	**Organizations and technical staff involved**	
1	Supervisor/project coordinator: Frants Vyshpolsky	%
	Organization: Kazakh Research Institute of Water Management (KazNIIVKH) Address: Taraz, K.Koygeldy 12 telephone: 2-49-65 fax: E-mail:	Staff resources 60 %
Other counterparts:	Organizations Surname First name	
1	KazNIIVKH, Rakhym Bekbaev	40 %
2		%
3		%
4		%
Other collaborators:	man-years	

F	**Funding agencies**	
	Full name or acronym	Percentage of project finance provided
1	Ministry for Agriculture of Kazakhstan	100 %
2		%
3		%

G	Summary of research project

1 *Objective and technical fields*:

Reduction of water consumption norms and raising the efficiency of irrigated lands through introduction of a drip irrigation system. Objectives: improvement of water use, reduction of water consumption, control of a water-salt regime of soils and their fertility with vertical drainage.

2 *Scientific and technical approaches:*

Optimization of a water-salt regime of soils on the basis of improvement of irrigated lands' drainability, reduction of water consumption norms through optimization of a soil moistening regime, applying of fertilizers with irrigation water during introduction of a drip irrigation technology. The experiment included adaptation of a drip irrigation technology for the local conditions and elaboration of measures on raising its efficiency.

3 *Environment characteristics:*

Climate is sharply continental. Average annual temperature is 13-15^{0}C. Average annual precipitation is 150-230 mm. Evaporativity is 1200-1400 mm. Average ten-day period temperature above 14^{0}C remains for 6 months since the middle of April till the middle of October. Relative air humidity is 80-85% in winter, 70-75% in March, 30-40% in May, it falls down to 20% in June. The territory of the cotton state farm is situated on a foot-hill plain with a slightly corrugated relief. Inclination is 0,002-0,003. Soils are made of multilayer quaternary deposits. Sickness of a cover loam layer is 7-15 m. The upper layer is loam, than (from 2-3 m) there are sandy loam, loam and clay layers. Sickness of gravel-shingle deposits is 12-18 m. Coefficient of permeability is 0,2-0,5 m/day (loam), 0,5-1,2 m/day (sandy loam). Specific yield is 0,10-0,12 (loam), 0,11-0,15 (sandy loam and sand). Under natural conditions the drainability of the territory is slight. In spring the depth of water table is 1,0-1,5 m, in autumn it is 3,0-3,5 m. Shallow ground water salinity is 1-2 g/l. Type of salinity is chloride-sulphate. Deep ground water salinity is 0,7-1,0 g/l. Type of salinity is chloride-sulphate. Salinity of drainage waters pumped by vertical drainage is 0,8-1,2 g/l. Type of salinity is chloride-sulphate. During 5 years of studies salinity of drainage waters was almost the same (within an experiment mistake). Soils are meadow-gray, humus percentage in the upper layer (0,6 m deep) varied from 0,7 to 1,0%. Content of nutrients is 2-5 mg/100 g of phosphorus and 4,5-8,5 mg/100 g of nitrogen. Degree of salinity of separate soil layers of the topsoil (1,5 m deep) is 0,09-0,12%. Volume weight is 1,4-1,5 g/cm^3, specific weight is 2,66-2,71 g/cm^3, field capacity is 20,9-23%

4. *Parameters of Pilot Projects and Technical Solutions:*

Gross area of the testing plot was 500 ha, net area was 450 ha. Efficiency of land use was 0,8. The pilot plot was constructed by Israeli company in spring, 1992. Cotton percentage was 100%. Water was abstracted from vertical drainage wells or a flume network. Main lines (with 70-120 mm diameter) were put down along the center of irrigation fields at the depth of 0,9-1,1 m. Each 21,5 m hydrants were installed to which distributing (surface) pipes with 40 mm diameter were connected. From two sides watering pipes (with 16 mm diameter) 230-280 mm long were connected. Distance between watering pipes was 1,8 m. Distance between drippers was 1 m. Operation head (MPa) was 0,2-0,25. Dripper discharge was 2,3 l/min per a long meter, diameter of a labyrinth outlet hole was 0,94 mm. Moistening uniformity along a watering pipe was 0,9, it was 0,8 between irrigation plots. Treatment was combined - desilting basins, filters (sand and rotation filters).

5 *Methodology:*

Field studies on movement of moisture, salts and nutrients; moistening regime and formation of a water-salt regime of soils using irrigation and drainage waters were carried out. The pilot plot was provided with necessary metering and accounting equipment. All the technical operations on cotton growing were carried out under the leadership of Israeli specialists.

Systems analysis of obtained results was used for estimation of the efficiency of the drip irrigation technology.

6 *Results*:

Before construction of the pilot plot cotton yield (for 5 years) was 2,3-2,7 t/ha. Annual duty of water was 6-7 th. m^3/ha. Initial irrigation norm was 1,4-1,6 th. m^3/ha, water storage irrigation norm was 1,4-1,6 th. m^3/ha, irrigation norm was 4,5-5,5 th. m^3/ha, depth of water was 1,3-1,5 m^3/ha. Soil moisture before irrigation was maintained at the level of 65-70% of the normal moisture. Average annual change of salt content was within the limits of +-, -3 t/ha. There was a stable tendency of salinity decrease. The ratio (water supply + precipitation) to (transpiration and evaporation) was 0,90-1,1. Ground water overflow from loam layers to gravel-shingle deposits was 1000-1500 m^3/ha, it was 1800-2500 m from gravel-shingle to loam deposits. The drip irrigation system operated in full force for 2 years (1992-1993). Operation was carried out under the leadership of Israeli specialists. In 1994-1996 the drip irrigation system was used on one plot and served by local specialists. In 1992 water storage irrigation was not made. Growing irrigations were made from June 12 till August 30. Number of irrigations was 11-12. Depth of water was 360-430 m^3/ha, irrigation norm was 4,2-4,5 th. m^3/ha. In 1993 water storage irrigation norm was 1,5 th. m^3/ha, number of irrigations was 10-11, depth of irrigation was 380-410 m^3/ha, irrigation norm was 3,9-4,2 th. m^3/ha, irrigation stopped on September 5. In 1995 water storage irrigation norm was 1,5 th. m^3/ha, number of irrigations was 10, depth of irrigation was 380-420 m^3/ha, irrigation norm was 4,0 th. m^3/ha. Irrigation started on June 10 and finished on August 20. Soil moisture before irrigation was 0,6-0,7 of normal soil moisture in an irrigated furrow and 0,55-0,65 of normal soil moisture in a non-irrigated furrow. After irrigation soil moisture rose up to 0,85-0,95 of the normal soil moisture in an irrigated furrow and to 0,6-0,7 of normal soil moisture in a non-irrigated furrow. Mineral fertilizers were applied with irrigation water. For 3 years of the application of the drip irrigation system content of nutrients was almost the same, under the furrow irrigation it reduced by 20-30%, which corresponded to the dynamics of the reduction of mineral fertilizers application doses. In 1992 450 kg/ha were applied, in 1993 350 kg/ha were applied. Salinity of a root soil layer (1,5 m deep) almost did not change and was 0,09-0,11%. In the second year of the drip irrigation system operation Israeli specialists decided to raise cotton yield through prolongation of the irrigation duration from August 10-15 (according to the zone technology) till September 5. This operation increased the duration of cotton ripening, that is why the most part of yield was covered by snow. Cotton yield was 2,5 t/ha in the first year, 1,5 t/ha in the second year, 2,6 t/ha in the third year. Average yield for 3 years was 2,45 t/ha. Since 1994 the number of simultaneously operating wells became reducing because of the rise in prices on pumping equipment and power sources. In 1996 the system of vertical drainage wells almost stopped operation. For this period (1995-1996) reclamation processes changed and soil salinity increased by 0,1% under the drip irrigation and by 0,15% under the furrow irrigation. In the first two years of application of the drip irrigation system the ratio of water supply and precipitation (6,0-6,5 th. m^3/ha) to the total evaporation (6,3-6,8 th. m^3/ha) was 0,88-1,03. Differences in the degree of salinity of a loam water bearing layer and gravel-0shingle deposits, change of the direction of their outflow during irrigation and existing drainage regime predetermined formation of the negative salt balance. In 1995 because of the reduction of the operation duration of the vertical drainage system, water supply reduced by 800-1000 m^3/ha, and ratio of water supply and precipitation to the total evaporation was 0,78-0,95 which caused secondary salinization processes. On the whole the salt balance of the root layer had a type of rising salt accumulation of 2-3 t/ha per year. Efficiency of the drip irrigation was determined on the basis of comparison of agricultural production in 1988-1991 and 1992-1994 obtained under the furrow and drip irrigation.

The main result of the researches was decrease of the annual water consumption norm by 20%, improvement of water supply of irrigated lands, reduction of manual labor, increase of investments and operational expenditures. Economical effect: losses of 200-500 ruble/year in prices of 1982-1984.

H	Suggested key-words		
1	Water-salt regimes	4	Change of the nutrition regime
2	Reduction of water consumption norms	5	Raise of the soil fertility
3	Improvement of water supply	6	Irrigation water saving

I	Most recent publications (maximum 3)			
1	Author(s): Frants Frantsevich Vyshpolsky			
	Title: The dynamics of the soil salt regime during change of the irrigation regime and technology			
	Publication details: Formation of the soil salt regime is considered, measures on raising soil fertility are determined, quantitative values of the reduction of irrigation norms during change of an irrigation technology under various hydrogeological conditions are described.			
	Year of publication: 1994	free access [•]	restricted [ ]	confidential [ ]
2	Author(s):			
	Title:			
	Publication details:			
	Year of publication:	free access [ ]	restricted [ ]	confidential [ ]