Studies of Seepage Losses in Lined Irrigation Channels

by

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Introduction: Investigations carried out by the Bihar Hydraulic Research Station, Khagaul, Patna indicated that one of the main difficulties in popularising the tube-well irrigation in this part of the country is the high rate of seepage and percolation losses in earthen channels. Assessment of seepage losses in Patna canal and Arrah canal systems showed wide variations at different sections of the two canals. Extraordinary loss of about 300 cusecs at a discharge of 2300 cusecs occurred within half a mile stretch of Patna canal. In case of Arrah canal a loss of about 60 cusecs at a discharge of 646 cusecs was recorded in a 10 mile stretch. Jain (1964) worked out economics of well irrigation and found that the costs of irrigation per acre-inch were Rs. 7.00, Rs. 2.80 and Rs. 4.75 for (i) unbored masonry well fitted with persian wheel, (ii) bored masonry well fitted with electric pump set and (iii) bored masonry well fitted with diesel driven pump set respectively. The cost of raising a crop of wheat requiring 10 acre-inches of irrigation works out to Rs. 70/- per acre and that of rice requiring 30 acre-inches as irrigation Rs. 210/- with persian wheel. Therefore, the importance of reducing seepage loss through field channels needs no further emphasis.

Different types of lining materials to check seepage losses have been recommended. Studies at the Irrigation Research Institute, Roorke, (Anon, 1962) included: brick lining with and without surface treatment, alkathene film lining, bituminous material, bentonite, cow-dung and molasses in various proportions and methods of applications. Bihar Institute of Hydraulic and Allied Research Station, Khagaul (Anon, 1965) studied lining materials which included bricks, tiles, sheet asphalt, plastic films, and bentonite layer below tiles. The council of Scientific and Industrial Research, New Delhi (Anon, 1963) after preliminary studies recommended plastering the 'Kacha' channel in $\frac{1}{2}$ inch thickness with a bituminous mixture at the rate of about 4 pounds for every cubic feet of dry soil made into a puddle and digested for a week with paddy husk or any type of *Bhusa*. Michael and Agrawal (1968) studied the performance of unlined channel, concrete, baked clay tiles and bituminous material at Jobner. Evaluation of seepage losses was carried out by ponding method. They concluded that seepage loss was negligible under all the three different materials used in lining. The cost of concrete lining was prohibitive for the farmer, but baked clay tiles and bituminous linings were cheap and could be used with some technical guidance. Dewan (1964) found that the losses per

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24 hours were 41.5, 18.96 and 100% for brick lining, brick lining sealed with 30/40 maxaphalt and unlined channels, respectively. It was also observed that percentages of loss of water in 24 hours were 11.2 in sheet asphalt, 15.9 in mastic grouting and 50.0 in mastic grouting over ½ inch sheet asphalt. Durability of these lining materials was also not encouraging. Loss of water with bentonite lining averaged 16.6 %. Channel lining with plastic film was discouraging due to weed penetration and consequential seepage loss.

Materials and Methods: With a view to study the effectiveness of some of the lining materials in reducing seepage loss in field irrigation channels trials were laid out at Sheikhpura Govt. Farm (Patna) during the year 1966 with the following lining combinations.

L_1 Unlined *Kacha* channel (Control)

L_2 Flat brick lining with cement flush pointing 1:6

L_3 Flat brick lining with cement mortar plaster 1.25 cm thick 1:6

L_4 *Kacha* channel plastered 2.5 cm thick with a mixture of cement, sand and cinder (coal ash) 1:2:5

L_5 *Kacha* channel lining with polyethylene film 600 gauge

L_6 Polyethylene film 600 gauge embeded under 15 cm thick layer of graded soil at the bottom and channel sides with flat brick and flush pointed with cement mortar 1:6

L_7 2.5 cm thick plastering with a mixture of mud and paddy *Bhusa*

For preparing the channel, the site was cleaned and weeds removed completely. Soil from which weeds were screened out was piled to form an embankment and consolidated layer by layer by ramming with additions of water by sprinkling. The embankment thus made was left during the rains to settle under natural conditions. During the following winter, earth was scooped out from the embankment to confirm to a predetermined cross-sectional area of the channel leaving adequate margin to accommodate the lining materials. Before lining material was applied as per schedule, the channel was again compacted and treated with Fernoxone weedicide. Application of lining materials was carried out and allowed to cure where necessary. Precautions were also taken to prevent mechanical damage to the linings by human or animal beings. The final cross-sectional area and the length of each channel section were 0.174 sq. metre and 30 metres, respectively. Each lined channel was further sub-divided into 3 sub-sections of 10 metres each for replicating trial readings. Studies of seepage losses were carried out by ponding method. Readings were taken with the help of fixed gauges at regular time intervals. Additional information in respect of seasonal effects, cracks, rodent holes and weed infestations were collected.

Brick lining (L_2): Brick lining was done with first class brick laid flat and flush pointed with cement mortar (1 : 6) and cured for 7 days.

Brick lining with cement plaster (L_3): First class bricks were laid flat and plastering done to a thickness of 1.25 cm with cement mortar (1 : 6) and cured for 7 days.

Polyethylene lining (L_4): Polyethylene black flat film 600 gauge in 304.8 cm width was laid on the channel surface and carefully spread to a smooth surface and anchored in place with earth at the two top flanks.

Brick cum Polyethylene lining (L_5): The film in 600 gauge thickness was laid under 15 cm deep soil at the bottom of the *Kacha* channel and compacted gently to a smooth surface. The film at the side walls was laid under first class flat brick and flush pointed with (1 : 6) cement mortar.

Cement-Sand-Cinder mixture lining (L_6): A mixture of cement, sand and cinder (burnt coal ash from the electric power house) was prepared in the manner of mixing cement concrete in the ratio of 1 : 2 : 5 and applied on the bottom, side-walls of the channel in the thickness of 2.5 cm and cured.

Mud-Bhusa plaster lining (L_7): Local soil was mixed with cow-dung and paddy bhusa and thoroughly mixed with the help of spade in the presence of adequate moisture. The mixture was worked with spade by adding water frequently till it was 10 days old. The mixture was made into a workable paste and applied to the channel in 2.5 cm thickness. Cracks and fissures appearing subsequently were treated with cow-dung slurry.

Results and Discussion: The cost of construction of the channels including materials used in lining and labour charges varied considerably. The costs per sq. metre surface area for L_1, L_2, L_3, L_4, L_5, L_6 and L_7 treatments were 1.87, 6.19, 7.28, 4.83, 5.21, 5.83 and 2.45 rupees respectively.

Unlined Kacha channel (L_1): The seepage losses in the unlined *Kacha* channel amounted to 111.30 litres / sq. m. / hour during the initial stage which increased to 179.10 lit./sq. m. per hour during May 1967. The loss recorded in April 1968 stabilised at 81.32 lit./sq. m./hour. It may be so because the channel may have settled to its final compaction during the monsoon rains of 1967.

Brick lined with cement flush pointing (L_2): The seepage loss in the brick lined channel at the initial stage of trial was of the order of 13.89 litres per square metre per hour at the end of the first hour during 1966 which came down to 6.66 after 8 hours. The initial higher rate of loss of water was perhaps due to soakage by brick work as well as the under lying earth. Water loss can be expected through pore-spaces of brick body. It was noticed that

the losses increased to 11.62 and 14.44 lit./sq. m./hour during 1967 and 1968, respectively. At the end of the first year a few weeds were noticed at the bottom joints where some soil had settled.

Brick lined with cement plaster channel (L_3): The loss of water due to seepage was the least in this case which amounted to 1.30 lit./sq. m./hour at the initial stage and 4.66 and 20.14 lit./sq. m./hour in May 1967 and April 1968, respectively. Condition of the channel was good. There has been no weed growth so far except for a few hair cracks noticed on the channel surface.

Cinder-sand cement plastered channel (L_4): The seepage losses through this channel amounted to 9.52, 13.44 and 16.37 lit./sq. m./hour in November 1966, May 1967 and April 1968, respectively. The rate of loss over the entire period from November 1966 to April 1968 was less than the brick lined and brick line-plaster channels.

Polyethylene lined channel (L_5): At the initial stage the channel gave satisfactory service and the loss was of the order of 10.13 lit. sq. m./hour. But six months later there was profuse growth of weeds underneath. As a result, the entire sheet was lifted several inches above channel surface and the film was punctured at numerous spots. Through these holes weeds appeared as outgrowths and covered most of the film surface. The film gave an appearance of an enormous sieve through which further seepage loss trial was impracticable.

Embedded Polyethelene Lining (L_6): The seepage loss through the embedded polyethylene channel was much less in comparison to the *Kacha* unlined channel and more durable than the surface lined polyethylene treatment. The seepage losses recorded in November 1966, May 1967 and April 1968 were 16.96, 41.28 and 31.99 lit./sq. m./hour, respectively. Surface growth of weeds was noticed; but much damage to the film had not taken place.

Mud-plastered channel (L_7): The behaviour of this treatment in respect of seepage losses and general physical condition was similar to the unlined *Kacha* channel. The losses at different stages of its life were 96.90, 137.2 and 81.33 lit./sq. m./hour during November 1966, May 1967 and April 1968, respectively.

Summary and Conclusions: A comparative study of different channel lining materials was conducted at the State Agricultural Farm, Sheikhpura (Patna) during 1966 to 1968 under the Centrally Sponsored Scheme for Research on Minor Irrigation and water use and the conclusions were:– (i) The seepage losses in the unlined *kacha* channel and the mud-plastered channel were of the order of 100 lit./sq. m./hour. (ii) Surface lining of *kacha*

channel with 600 gauge polyethylene black film gives most unsatisfactory service in preventing seepage loss of water. It is prone to weed penetration and is not durable. (iii) Embedded polyethylene black film of 600 gauge gives satisfactory service for sometime. (iv) Considering the cost of construction, durability and seepage loss in conveyance irrigation channel, lining with a mixture of cinder, sand and cement in the ratio of 5:2:1 to a thickness 2.5 cm gave the best results.

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A Study on the Effect of Phosphorus and Molybdenum on the Yields of Berseem Fodder

by

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Introduction: It has been reported by various workers that the application of molybdenum and P increases the yield of leguminous crops. The increase in the yield of berseem with the increasing doses of P on soils having low available P_2O_5 has been reported by Sen and Bains (1951, 1955) and Daljit Singh *et al.* (1957). Mehrotra and Gangwar (1964) reported an increase of 21% over control with molybdenum treatment. Rao and Raju (1964) reported that molybdenum when applied singly or in combination with boron did not affect the yield of alfalfa significantly. The present study was undertaken with a view to ascertain the suitable doses of P and molybdenum for the growth of berseem on the soils of Jobner tract which are sandy in nature and also to determine whether any interaction exists between the doses of P and molybdenum. It was also intended to adjudge the efficacy of soil and foliar application of molybdenum.

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