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Research Paper :

Study of cost economics and water quality aspect of different floating materials in small farm ponds

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ABSTRACT

India receives an average annual rainfall of 370 Mha-m. Out of this amount about 210 Mha-m are lost as river flow and deep percolation. The balance of 160 Mha-m is only available for evaporation and transpiration. Efforts are made in this to test the different floating materials for cost economics and water quality aspect. The main objectives in this study was to study the cost economics and water quality aspect of different floating materials as thermacol balls, sorghum straw, cottonseed oil and cetyl alcohol The twenty plastic tubs of dimensions having 60cm as top diameter, 40cm as bottom diameter and 30cm depth were selected for the experiment. The evaporation was measured by point gauge. It is seen that the average evaporation rate of 30 days experiment (19th Oct-21st Nov) were 2.45, 4.23,3.35 and 3.52 in case of thermacol balls, sorghum straw, cottonseed oil and cetyl alcohol, respectively. The cost of saving of one litre of water in case of thermacol balls, sorghum straw, cottonseed oil and cetyl alcohol was found to be Rs. 0.29, Rs. 0.03, Rs. 0.10 and Rs. 0.62 per liter of water, respectively. The cetyl alcohol showed more cost of saving of one litre of water than other treatments. The ratio of Mg and Ca were estimated to be 0.56, 0.92, 0.73, 1.07 and 0.35 in case of control, thermacol balls, sorghum straw, cottonseed oil and cetyl alcohol, respectively. This also show that there was no effect on the quality of water due to covering of these materials as the value of Mg/Ca ratio is less than 1.5.

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Evaporation from water storages can account for between one third and one half of all water lost on farm with every 100mm of evaporation resulting in 1 ml of water lost to the atmosphere from every hectare of surface area. Evaporation reduction achieved under ideal conditions, actual, reduction was much lower and use of monomolecular films to reduce evaporation has no practical application. Instead more success has been obtained with floating objects like ping pong balls, Styrofoam blocks or empty bottles (Myers and Frasiers, 1970, Codey and Myers, 1973, Andrew Brier, 2004). Floating objects use the same principle as floating covers, however, rather than a continuous cover; multiple individual units are used, often floating freely. This allows for easier installation and maintenance of the cover but reduces the evaporation reduction efficiency.

In the present study, the different floating materials as thermacol balls, sorghum straw, cottonseed oil and cetyl alcohol are selected for reducing evaporation losses and the methodology and results are presented here.

METHODOLOGY

The twenty plastic tubs were used for evaluation of different covering materials for reducing the evaporation. The tubs were fixed into the soil up to the collar by digging a pit. The plastic tubs of dimensions having 60cm as top diameter; 40cm as bottom diameter and 30cm depth were selected for the experiment. Experimental Treatments: Experimental treatments selected as thermacol balls, sorghum straw, cottonseed oil and cetyl alcohol. T_1 - Control, T_2-Thermacol balls, T_3- Sorghum straw, T_4- Cotton seed oil and T_5- Cetyl Alcohol Evaporation analysis: All tubs were filled with water up to 25cm height. The point gauge with the least count of 0.1 mm was used to measure fall in water level due to evaporation. The evaporation was measured daily at 8.30h and 17.30h. Statistical, water quality and cost analysis were carried out by standard procedures

RESULTS AND DISCUSSION

The data in respect of evaporation during day hours,

night hours and 24 hours were recorded over thirty days by covering the tub water using thermacol balls, sorghum straw, cottonseed oil and cetyl alcohol.

Evaporation influenced by different treatments during day hours (8.30-17.30h):

The maximum per cent reduction was observed in case of thermacol balls (52.47%), followed by cetyl alcohol (39.60%), cottonseed oil (29.31%) and sorghum straw (21.03%), respectively over control.

Evaporation influenced by different treatments during night hours (17.30-8.30h):

The maximum evaporation was observed in uncovered water and ranged from 0.5 to 1.9mm. The difference between these two treatments was observed to be statistically significant. The next minimum evaporation was recorded in case of cottonseed oil, followed by cetyl alcohol and sorghum straw. The maximum per cent reduction was observed in case of thermacol balls (44.35%), followed by cottonseed oil (18.26%), cetyl alcohol (7.83%) and sorghum straw (5.22%), over control i.e. uncovered water.

Evaporation influenced by different treatments during 24 hours:

The minimum evaporation was recorded when water covered with thermacol balls and ranged from 0.9 to 4.9mm. The maximum evaporation was recorded in uncovered water and ranged from 4.2 to 7.9mm. The highest per cent reduction was observed in case ofthermacol balls (51 %) followed by cottonseed oil (32.65%), cetyl alcohol (29.57%) and sorghum straw (14.28%), respectively over control.

Cost analysis:

The rate of application of different materials was found to be 53.57g, 62.00g, 127.55g and 51.00g in case of thennacol balls, sorghum straw, cottonseed oil and cetyl alcohol, respectively. Table 1 shows the estimated cost of covering of different materials. From the table, it is clear that the cost of covering with sorghum straw was the lowest at the rate of Rs. 0.62/m^2 whereas that of cetyl alcohol was found to be costly as the cost of covering was of Rs. 25.50/m^2. The cost of saving of one litre of water in case of thermacol balls, sorghum straw, cottonseed oil and cetyl alcohol was found to be Rs. 0.29, Rs. 0.03, Rs. 0.10 and Rs. 0.62 per liter of water, respectively. The cetyl alcohol showed more cost of saving of one litre of water than other treatments.

Water quality analysis:

The different quality parameters as affected by different floating materials were analyzed after the completion of the experiment. The results in respect of water quality are presented in Table 2. The results show that, the quality of water in all the treatment felt in C_1S_1 group on the basis of SAR and SSP.

Similarly the ratio of Mg and Ca were estimated to be 0.56, 0.92, 0.73, 1.07 and 0.35 in case of control, thermacol balls, sorghum straw, cottonseed oil and cetyl alcohol, respectively. This also shows that there was no effect on the quality of water due to covering of these materials as the value of Mg/Ca ratio was less than 1.5.

Results obtained on various aspects in present investigation, the per cent reduction in evaporation was

Table 1 : Cost estimates of different covering materials on the basis of 30 days experiment

Covering materials	Quantity required (g/m^2)	Cost of covering (Rs./m^2)	Reduction in evaporation rate (%)	Quantity of water saved (1)	Cost of saving of water (Rs./l)
Thermacol balls	53.57	21.43	50.00	73.50	0.29
Sorghum straw	62.00	0.62	13.67	20.10	0.03
Cotton seed oil	127.55	5.00	31.63	46.50	0.10
Cetyl alcohol	51.00	25.50	28.16	41.40	0.62

Average daily evaporation in uncovered water surface = 4.90mm

Table 2 : Quality parameters of water

Treatments	pH	EC	CO_3 (meq/l)	HCO_3 (meq/l)	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	K (meq/l)	SAR (%)	SSP (%)
Control	8.16	1.39	78.4	14	22.4	12.6	3.2	10.2	0.59	6.51
Thermacol balls	8.19	1.34	86.4	2.0	5.4	5.0	3.3	0.1	1.17	23.91
Sorghum straw	8.42	1.34	130.4	4.4	9.0	6.6	3.7	12.9	1.05	11.49
Cotton seed oil	7.48	1.59	48.8	8.0	7.6	8.2	3.3	0.6	0.96	15.75
Cetyl alcohol	8.02	1.44	94.4	2.4	10.2	3.6	3.5	0.3	1.0	19.88

higher in case of thermacol balls followed by the cottonseed oil, cetyl alcohol and sorghum straw. But when compared on the basis of cost, the lowest cost of covering was required in case of sorghum straw because it is amply available with farmers. It is also reported that the cetyl alcohol and cottonseed oil get melted due to lower temperature in winter season and melt is collected at one side of the pond, which uncovers the water, and purpose of reducing evaporation gets affected. While studying, it was also observed that after 2-3 days when sorghum straw get wet, it becomes heavier than water and accumulated at the base of the tub, it affect the purpose. Hence, considering all the aspect, the thermacol balls can be used efficiently for reducing the evaporation losses though the layer of thermacol balls get disturbed due to wind velocity, which can be adjusted with no extra cost. Further, the thermacol balls can be reused from season to season.

On the basis of average evaporation of day, night and 24 hours, it was seen that minimum evaporation is observed in case of thermacol balls followed by cottonseed oil, cetyl alcohol and sorghum straw as compared to control i.e. uncovered water. The reduction in evaporation in case of, thermacol balls, cottonseed oil, cetyl alcohol and sorghum straw as compared to control was observed to be 50%, 32%, 28% and 14%, respectively. The cost of covering with sorghum was lowest at the rate of Rs.25.50/ m^2. By and large the treatment of thermacol ball was found to be more efficient considering effectiveness in reducing evaporation losses, life of material and ease in operation as floating material.

Conclusion:

The data obtained from the field were analysed to determine the evaporation rates in different treatments. Per cent reduction due to different covering materials over control was also estimated. The cost analysis of different materials was carried out on the basis of 30 days experiment. The different quality parameters of water as SAR, SSP and Mg/Ca ratio were determined to check the quality of water and different materials.

From the study, the following conclusions were drawn

– The reduction in evaporation in case of thennacol balls, cottonseed oil, cetyl alcohol and sorghum straw as compared to control was observed to be 50%, 32%, 28% and 14%, respectively.

– The cost of covering with sorghum straw was lowest (Rs. 0.62/m^2) and that of cetyl alcohol was highest (Rs. 25.50/m^2).

– Cost of saving of one liter of water of thermacol balls, sorghum straw, cottonseed oil and cetyl alcohol was found to be 0.29,0.03,0.10 and 0.62Rs/l.

– There was no effect on quality of water due to covering of different materials *viz.,* thermacol balls, sorghum straw, cottonseed oil and cetyl alcohol.

– Sorghum straw was observed to affected by water, it gets settled down in the bottom of the tub within 2-3 days and hence, it required adding the straw frequently, resulted in higher operational and material cost.

– By and large the treatment of thermacol ball was found to be more efficient considering effectiveness in reducing evaporation losses, life of the material and ease in operation as floating material.

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