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The effect of heavy alcohols on free water evaporation

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1 Introduction

The research for free water evaporation control with heavy alcohols (cetyl, and stearyl alcohols; C6H33OH and C18H37OH respectively) started in 1920_s (for example Rideale, 1925). Preceding research suggest the evaporation rate is diminished with these materials. These polar alcohols are absorbed by water through one pole and are retarded by the other; the first pole is located blow water surface and the other above. Theoretically evaporation rate and latent heat transfer and the rate of rise for electrical conductivity (EC) are reduced with a monomolecular film layer of these materials on water surface. With more film layer application up to a maximal rate the evaporation rate is reduced accordingly (McArthur and Durham, 1957). But for the best result the actual application is about 18 molecular layers equivalent to 25 gram per hectare (Jaya Rami Reddy, 1986). þ Based on this conception a research study was established in Abgasht Fish Production Unit (AFPU) with a hundred reservoirs, 5 hectares each. This unit is located approximately 37^0 22J north and 54^0 30´ east; 65 kilometers north of Gorgan County (Soil and Water Research Institute, Agricultural and Natural Resources Research Division, Iranian Ministry of Agriculture, 1991). These reservoirs are fed by Atrak River. In dry years with lower river discharge, the replenishment of reservoirs is diminished leading to limiting electric conductivity rises and lower production yield. Reduction of evaporation rate in an area like AFPU (with more than 10 mm a day in summer months) may result a lower rate in EC rise and hence a greater production in dry years.

2 Core

Free water evaporation (as control) and evaporation from free water with cetyl and stearyl alcohol treatments were compared using class A U.S. pans with a completely randomized design with 4 replications in AFPU, nearby reservoirs. The water in pans was from reservoir. 0.75 mg of cetyl and stearyl alcohols were solved in ethanol and sprayed on pans for relevant treatments. The depths of water, electrical conductivities and temperatures were measured in 6 different occasions (Table 1).

Daily evaporation rates for different time spans are found in Table 2. For no date a significant statistical difference was found between evaporation rates, temperatures and EC_s comparing treatments (SAS, 1996). Alcohol films were stable before 20/07/2003. A cover of atmospheric dust was observed on water surface in pans with cetyl and stearyl alcohol treatments at 08/07/2003 but control was clear. At 20/07/2003, all treatments were clear. Alcohols might had stuck to dust and sunk before 20/07/2003.

Cetyl and stearyl alcohols were unknown to AFPU managers and for this reason they provided us only with two reservoirs for this research, 2.5 hectares each. 62.5 gram of cetyl alcohol was sprayed on one reservoir (same rate as pans) and the same factors as pans were also measured in 8 different dates in this reservoir and the other as the control (data not shown). Evaporation rates, temperatures and EC_s were not different for treatments.

3 Conclusion

Evaporation rates, temperatures and electrical conductivities were not affected by cetyl and stearyl alcohols in AFPU despite the others findings (Linsley, Kohler and Paulhus, 1985; Jaya Rami Reddy, 1986; Varma, 1996). Except at times with wind speed greater than 24 kilometers per hour (Varma, 1996) some effects by these alcohols is expected. The daily evaporation rate was more than 10 mm/day (Table2). Results with other researchers were generally obtained in less demanding situations for evaporation.

There might be marginal evaporation potentials at which heavy alcohols show minor or no effect on evaporation control. Measuring evaporation rate with these materials at a wide range of evaporation potentials may give a clearer prospective.

4 References

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Table 1- Location of water relative to upper surface (cm) in class A U.S. evaporation pans, electrical conductivity (ds/m) and water temperature (centigrade degrees) at different dates and hours

Time / Treat	26/06/2003 Hr: 14:30			08/07/2003 Hr: 9:45			08/07/2003 see * below		
	T	EC	D	T	EC	D	T	EC	D
H1	30.4	-	3.1	27.8	4.74	13.0	-	4.01	3.0
H2	31.5	-	4.1	27.3	5.17	13.9	-	4.12	2.4
H3	30.6	-	3.0	27.8	4.73	13.2	-	3.52	2.6
H4	30.9	-	2.5	27.2	4.75	12.1	-	4.07	2.9
O1	30.9	-	3.3	26.9	4.79	13.7	-	4.05	3.0
O2	30.4	-	2.8	27.6	4.76	13.2	-	4.34	3.2
O3	30.4	-	3.4	27.8	5.01	13.5	-	4.08	2.9
O4	30.5	-	2.3	27.8	4.69	12.1	-	4.08	2.3
C1	-	-	3.4	27.4	4.14	13.3	-	3.61	2.9
C2	30.2	-	3.5	27.5	5.31	14.0	-	4.22	2.6
C3	31.6	-	2.2	27.2	4.54	12.0	-	3.95	3.1
C4	29.9	-	3.0	27.7	4.76	13.1	-	3.98	2.1

*Pans were replenished by water at 12:10

Table 1- Continued . . .

Time / Treat	10/07/2003 Hr: 10:20			15/07/2003 Hr: 14:50			20/07/2003 Hr: 9:40		
	T	EC	D	T	EC	D	T	EC	D
H1	26.3	4.11	5.0	32.7	5.11	9.5	28.3	6.85	13.9
H2	26.2	4.27	4.5	32.5	5.14	9.2	27.3	6.55	13.6
H3	26.4	4.09	4.6	33.0	4.98	9.3	27.7	6.54	13.9
H4	26.5	4.16	4.7	33.1	5.14	9.2	28.2	6.89	13.5
O1	26.2	4.19	5.1	32.0	5.09	10.0	27.3	6.72	14.5
O2	26.3	4.48	5.2	32.6	5.66	10.2	28.2	7.40	14.5
O3	26.4	4.19	4.6	32.9	5.17	9.5	28.1	6.99	14.0
O4	26.2	4.18	4.2	32.7	5.21	8.7	28.0	6.89	13.0
C1	26.1	3.72	5.0	32.7	4.43	9.5	27.3	5.85	13.9
C2	26.3	4.34	4.9	32.2	5.36	10.0	27.3	6.89	14.5
C3	26.4	4.02	5.0	32.9	5.09	9.5	28.0	6.98	13.7
C4	26.2	4.04	4.1	32.6	4.93	9.1	28.0	6.57	13.5

D is depth and T is temperature

Table 2- Mean treatment daily evaporation rate (mm/day) for different time spans in class A U.S. evaporation pans in AFPT assuming a correction value of one.

Date / Treatment	15/07/03-20/07/03	10/07/03-15/07/03	08/07/03-10/07/03	26/06/03-08/07/03
cetyl alcohol	9.0	15.0	10.0	8.0
stearyl alcohol	9.0	16.0	10.0	8.0
control	9.0	16.0	10.0	8.0