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DRY CULTIVATION AS AN EFFECTIVE METHOD FOR BERSEEM IRRIGATION MANAGEMENT

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ABSTRACT

Two field experiments were conducted at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate, North Nile Delta region during the two growing seasons of 2003/2004 and 2004/2005. The main objective of the study was to assess dry cultivation of Egyptian clover (Berseem) as an effective way for water saving instead of the common wet cultivation. The two cultivation methods were compared using four different equations and methods for the amount of irrigation water. They were (1) using soil moisture depletion method (SMD), (2) watering till 5.0 cm above soil surface, (3) using Ibrahim equation of ETp = 0.1642 + 0.6 Ep and the Evaporation Pan equation. Dry cultivation of Berseem resulted in a saving water of 145.0 m^3/fed and a yield which is rather similar to the yield obtained by the wet cultivation method; and higher values of yield per unit of applied water (WUE) as well as consumed water (WU + E) averaging 17.54 and 17.49 kg/m^3 for each, respectively.

INTRODUCTION

Shortage of irrigation water may occur in Egypt in the future. Irrigation uses more than 85% of the total renewable water in Egypt. So, tremendous efforts should be implemented in this sector to rationalize water at the national level. One of the most effective ways for irrigation management at the farm level is to determine precisely the actual irrigation water which should be applied to meet the needs of growing plants. Water excessive as well as insufficient irrigation results in decreasing crop yield. Egyptian clover (Berseem) is one of the main forage crops in Egypt. The national cultivated area of Berseem is above 2.5 million feddan (1 feddan = 4200 m^2) or one third of the principal green forage crop. The traditional method of cultivating Berseem is a wet one which called "El-Hamaa" is to apply excess water before sowing then broadcast the seeds over the wet glistening surface of the soil, such a method allows .for a thin, nearly uniform cover of soil over the seeds and ensures a high rate of germination.

The impact of irrigation on Berseem as seasonal crop as well as alfalfa as perennial one was investigated by several researchers either in Egypt or worldwide. Ibrahim *et al.* (1988) in Kafr El-Sheikh Governorate, North Nile Delta, Egypt found that the percentages of water shortage varies between 3.61 in September to 39.51% in June. Mahrous *et al.* (1984) stated that the average

values of clover consumptive use at Sakha, Egypt were 66.62, 59.13, 51.49 and 39.78 cm for wet, moist, medium and dry soil moisture levels respectively. El-Gibali and Badawi (1978) found that the seasonal water used by clover (continuos) were 45.0, 46.1 and 49 cm for lower, middle, and upper Egypt respectively. Abbas *et al.* (1995) studied the effect of the planting method and the irrigation scheduling (one, two and three irrigations between cuttings) on fresh and dry yield of Berseem. Results revealed that the optimum yield was obtained from the two methods of planting; i.e. the El-Lamaa method and the dry method with three irrigations between cuttings. The effect of irrigation regime on alfalfa was investigated by many researchers worldwide such as Karimi *et al.* (1983); Donovan and Meek (1983); Sharma *et al.* (1983) and Sharratt *et al.* (1983).

The main objective of this investigation was to find out assess the effect of the dry cultivation method and irrigation amount on Berseem crop. Specific goals were:

1. The impact of dry Berseem cultivation on water saving.
2. Determination of irrigation and water consumption for Berseem in North Nile Delta.
3. The interaction effect of both cultivation methods and irrigation amount on crop-water efficiencies.
4. To find out an extension procedure regarding the management of irrigation Berseem at the farm level.

MATERIALS AND METHODS

Two field experiments were conducted during winter seasons 2003/2004 and 2004/2005 at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate, Egypt using Berseem (Egyptian clover). Table (1) shows physical proprieties of the soil of the field where the experiments were carried out. Dates of sowing (S) and cuttings (C) were as follow:

Season 1: S = 26/10/2003
C_1 = 1/1/2004, C_2 = 15/2/2004, C_3 = 1/4/2004, C_4 = 1/5/2005

Season 2: S = 27/10/2004
C_1 = 4/1/2005, C_2 = 19/2/2005, C_3 = 4/4/2005, C_4 = 10/5/2005

Normal cultural practices followed by farmers of the region were carried out except for the two factors under investigation of the agricultural methods of sowing and amount of irrigation water (IW).

Experimental design and treatment:

The experimental design was a factorial, split plot design with three replicates, involving two factors i.e. cultivation method and irrigation amount. Main plots were assigned to the cultivation method. There were two methods (1) dry cultivation and (2) wet cultivation. Dry cultivation involves the use dry seeds broadcast over the dry soil. Wet cultivation (El-Lamaa) involves the use of presoaked seeds broadcast over the wet soil. The subplots were assigned to the irrigation amount. There were four water applications as follows:

Table (1): Physical proprieties of soil of the location where Egyptian clover (Berseem) was performed.

Soil depth (cm)	Physical properties								
	Particle size distribution, %			Textures	Bulk density (Mg/m^3)	Total porosity %	Field Capacity %	PWP	A.W.
	Sand	Silt	Clay	Class					
0-15	12.3	33.3	54.4	Clay	1.26	52.45	47.50	25.69	21.81
15-30	20.2	34.2	45.6	Clay	1.30	50.94	39.87	21.66	18.21
30-45	20.4	41.4	38.2	Clay loam	1.29	51.32	38.40	20.86	17.54
45-60	21.1	41.5	37.4	Clay loam	1.38	47.92	36.39	19.78	16.61
Mean	18.5	37.6	43.92		1.31	50.66	40.54	22.00	18.51

* PWP: Permanent wilting point, AW: Available water, ** Mg: megagram i.e. 10^6g

1. Soil moisture depletion method (S.M.D.), (direct method):

Irrigation water was equal to the water needed to raise the moisture content before each irrigation to field capacity(F.C).

$$S.M.D. = \frac{F.C-\theta}{100} D_b \times d \times A$$

Where:

SMD = Soil moisture depletion in the effective root zone = 60 cm

θ = Soil moisture percentage (w/w), before irrigation.

D_b = Soil bulk density Mg/m^3

d = Soil wetting depth i.e. effective root zone of 60 cm

A = Irrigation area.

2. Irrigation till the water reaches 5.0 cm above the soil surface.

3. Ibrahim equation (1981)

$$ETp = 0.1642 + 0.8\ EP$$

Where:

ETp = Potential evapotranspiration, cm/day

EP = Pan evaporation, cm/day.

4. Pan evaporation as described by Eid *et al.* (1982):

$$ETo - K_{pan} \times E_{pan}$$

Where:

ETo= Reference evapotranspiration

K_{pan} = Pan coefficient which depends on type of pan, conditions of humidity, wind speed and pan environmental conditions.

E_{pan} = Pan evaporation in mm/day and represents man daily value of considered period.

Thus the total number of experimental plots was 24 (2 "methods" x 4 "water amounts" x 3 "replicates")

Data collection:

1. Irrigation water (IW)

The feeder canal received the water from a branch where a measuring weir was fixed upstream with a discharge rate of 0.1654 m^3/sec. at 10 cm as effective head over the fixed rectangular weir crest.

2. Consumptive use:

To compute the actual consumed water of the growing plants, soil moisture percentage was determined gravimetrically, on weight basis before and after each irrigation as well as at harvesting. Soil samples were taken from the successive layers of the effective root zone, 0-15, 15-30, 30-45 and 45-60 cm. This method of computation is considered as one of the direct methods of consumptive use determination which is based on soil moisture depletion (S.M.D.) or so called crop-water consumed (ETc) as stated by Hansen *et al.* (1979).

$$SMD = CU = \frac{\theta_2 - \theta_1}{100} D_b \times d \times A \ (m^3/fed.)$$

Where:

SMD =Soil moisture depletion in the effective root zone = 60 cm.
CU =Consumptive use of the growing plants.
θ_1 =Mean soil moisture percentage (w/w) before irrigation for the 60 cm soil depth.
θ_2 =Mean soil moisture percentage (w/w) for the 60 cm soil depth, 48 hrs after the preceeding irrigation (field capacity).
D_b =Mean soil bulk density , Mg/m^3 for the 60 cm soil depth
D =Soil wetting depth i.e. effective root zone of 60 cm
A =Irrigation area, m^2.

3. Crop yield:

The obtained data of crop yield for each cut as well as the seasonal yield was subjected to statistical analysis according to Snedecor and Cochran (1967).

4. Crop-Water efficiency:

Crop water efficiency was calculated as follows (Doorenbos and Pruitt, 1975).

$$WUtE = \frac{\text{Yield (kg/fed.)}}{\text{Water applied } (m^3/\text{fed.})}$$

$$WUE \frac{\text{Yield (kg/fed.)}}{\text{Water consumed by crop } (m^3/\text{fed.})}$$

Where:

WUtE = Water utilization efficiency (kg/m^3) and WUE = water use efficiency (kg/m^3).

RESULTS AND DISCUSSION

Water applied (WA):

Water received by the Egyptian clover (Berseem) was from two sources (1) irrigation water (IW) and (2) rainfall (RF) as shown in Table (2) and Figure (1). Under dry cultivation, irrigation water of A_4 treatment was the lowest of 1705.4 m^3/fed., while the highest of 2319.6 m^3/fed. occurred with A_2. Mean values of the treatments of applied irrigation water (IW) during the course of study of the two seasons for the dry cultivation are 2040.1, 2319.6, 1779.9 and 1705.4 m^3/fed. for A_1, A_2, A_3 and A_4, respectively. On the other hand, for the wet cultivation, the

corresponding lowest and highest values are 1870.8 and 2469.1 m^3/fed. for B_4 and B_2, respectively. Mean IW values are; 2140.7, 2469.1, 1945.3 and 1870.8 m^3/fed. for B_1, B_2, B_3 and B_4, respectively. Therefore, the dry cultivation is associated with lower amounts of irrigation water. and *vice versa* for the wet cultivation.

Thus, the saving of water obtained by the dry method reaches, 100.6, 149.5, 165.4 and 165.4 m^3/fed. for each of the irrigation treatments, respectively with an overall average of 145.2 m^3/fed. i.e. 3.5 cm (6.85%). This shows that the dry cultivation of Berseem could achieve a saving of water of 360 million cubic meter national level, considering a berseem area of 2.5 million feddan. such saving of irrigation water is enough to cultivate a new area of more than a half million feddan, on the basis of 7 000 m3/fed. as yearly water needs.

Therefore, dry cultivation of Berseem could be an effective and a simple way towards water saving.

Seasonal water applied consists of I.W plus rainfall (RF). Seasonal RF was 7.00 cm and 13.00 cm during the first and the second seasons respectively. Thus, the mean total water applied (Fig. 1) equals 2050.1, 1, 2329.6, 1789.9 and 1715.4 m^3/fed. for the dry treatments of A_1, A_2, A_3 and A_4, respectively and 2150.7, 2479.1, 1955.3 and 1880.8 m^3/fed. for the wet treatments of B_1, B_2, B_3 and B_4, respectively. This shows that under dry cultivation, irrigation water represents 82.4% on average of the total seasonal water applied. The corresponding percentage under wet cultivation is 83.4%.

Table (2): Seasonal water applied (IW: irrigation water; RF: rainfall) for dry and wet cultivation method and irrigation treatments for Egyptian clover (Berseem), expressed in m^3/fed. and cm.

Treatment	Dry cultivation*				Wet cultivation *			
	A_1	A_2	A_3	A_4	B_1	B_2	B_3	B_4
	Season 1 (2003-2004)							
LW., m^3/fed.	2049.7	2333.1	1695.1	1644.6	2177.9	2547	1853.9	1803.4
LW., cm	48.8	55.6	40.4	39.2	51.9	60.6	44.1	42.9
RF, m^3/fed.	← 294 →				← 294 →			
(cm)	← 7 →				← 7 →			
	Season 2 (2004-2005)							
LW., m^3/fed.	2030.5	2306.0	1864.7	1766.1	2103.5	2391.1	2036.7	1938.1
LW., cm	48.3	54.9	44.4	42.1	50.1	56.9	48.5	46.1
RF, m^3/fed.	← 546 →				← 546 →			
(cm)	← 13 →				← 13 →			
	Means of 2 seasons							
LW., m^3/fed.	2040.1	2317.6	1779.9	1705.4	2140.7	2469.1	1945.3	1870.8
LW., cm	48.55	55.25	42.14	40.65	51.0	58.75	46.3	44.5
RF, m^3/fed.	← 420 →				← 420 →			
(cm)	← 10 →				← 10 →			

* Irrigation treatments are as follows (calculations of applied water):

A_1 (or B_1): Soil moisture depletion method.

A_2 (or B_2): irrigation till 5.0 cm water above soil surface

A_3 (or B_3): ETp = 0.1642 + 0.8 EP

A_4 (or B_4): Pan evaporation equation.

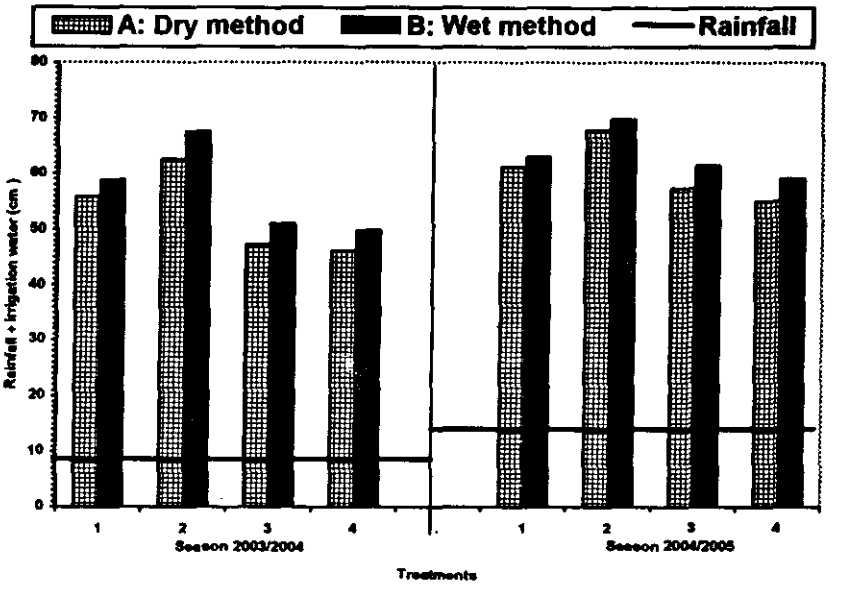

Fig. (1): Amount of water applied using four different treatments of calculations under two methods of Berseem cultivation (treatments: 1: soil moisture depletion; 2: irrigation till 5.0 cm water above soil surface; 3: ETp: 0.1642 + 0.8 Ep; 4: Pan evaporation equation).

Therefore, the dry cultivation method of Berseem may allow the following advantages:

1. Water saving of more than 360 million cubic meters at the national level, considering the average annual berseem area.
2. Such water saving can be used in cultivation of new land of more than 500,000 fed. (on the basis that 1 fed needs 7000 m^3 water annually for two successive crops).

The methods used in this study in calculating irrigation water give values nearly approach that of the standard method which takes in consideration the soil moisture depletion from the root zone i.e. the so-called soil moisture depletion (SMD) method with an accuracy percentage 1.13, -12.8 and -16.4%, respectively under dry cultivation. Under the wet cultivation, the corresponding percentages are 1.12, -9.13 and -12.61% respectively. This difference under the two cultivation methods could be attributed to that under the standard method of SMD, an additional value of 10% from SMD was added as leaching requirement (LR). In this direct the 5.0 cm depth of watering is resulted in high values in irrigation water, so, it is useful to reduce such depth to a less value, say 3-4 cm instead f the 5 cm. Regarding, the other methods, the variance is due to no LR was added.

Excess water was applied under the wet method which resulted in the highest yield, although not to significant level compared with the dry methdo. In this manner, under the conditions of water deficit facing Egypt at present, it is not advisable to implement the dry cultivation of Berseem, as well as to decrease the irrigation level from the traditonal of about 7-10 cm to less than 5 cm above soil surface. These finding are in agreement with those obtained by Abbas *et al.* (1995), who reported that seasonal water applied increased under the wet method by 9.32 and 8.65% compared with the dry method.

Crop consumptive use (CU):

Seasonal crop consumption use (CU), which also my be referred as "crop evapotranspiration, ETc" was computed on the basis of water depletion from the effective root zone of the upper 60 cm soil depth. Values of seasonal CU and their rates for the Berseem using the two cultivation methods and irrigation treatments are presented in Table (3). It is obvious that the consumptive use increased in the same line with increasing the applied water. Mean values of CU in the two growing seasons for the dry cultivation are 46.68, 49.22, 44.08 and 44.89 cm for A_1, A_2, A_3 and A_4, respectively. The corresponding values for the wet cultivation are 50.30, 54.75, 49.15 and 43.43 cm for B_1 through B_4 treatments, respectively. Under the dry cultivation method, seasonal CU was less by an amount of 3.62, 5.53, 5.07 and 3.54 cm compared with the wet cultivation method. The stated values were calculated under the different irrigation level of B_1 through B_4, respectively. Therefore, the mean seasonal saving in CU is 4.44 cm which equals 186.5 m^3/fed.

Table (3): Seasonal consumptive use (CU, cm) and its rates (cm/day) for Egyptian clover (Berseem), as affected by agricultural methods and irrigation treatments in the two growing seasons.

Treatment	Dry cultivation				Wet cultivation			
	A_1	A_2	A_3	A_4	B_1	B_2	B_3	B_4
	Season 1 (2003-2004)							
CU, cm	44.38	50.68	42.69	42.30	49.34	55.97	47.59	46.88
CU rate*(cm/day)	0.23	0.27	0.22	0.22	0.26	0.30	0.25	0.25
	Season 2 (2004-2005)							
CU, cm	48.97	47.75	45.47	47.48	51.26	53.52	50.70	49.97
CU rate (cm/day)	0.25	0.24	0.23	0.24	0.24	0.26	0.25	0.25
	Means of 2 seasons							
CU, cm	46.68	49.22	44.08	44.89	50.30	54.75	49.15	48.43
CU rate (cm/day)	0.24	0.26	0.23	0.23	0.26	0.28	0.25	0.25

* Growing season was 197 days, see footnote of Table 2.

For the rate of CU, it is obvious from the same Table (3), that the seasonal values of CU rate under the dry method received 2.4, 2.6, 2.3 and 2.3 mm/day for the four respective irrigation treatments. The corresponding values under wet cultivation 2.6, 2.8, 2.5 and 2.5 mm/day, respectively.

Thus, it might be concluded that both CU and its rate are having the same trend of applied irrigation water.

Seasonal CU of Berseem under the dry cultivation is about 1941.13 m^3/fed. or 46.22 cm with a seasonal rate of 2.4 mm/day for a growing season of 193 days.

On the other hand, under the wet cultivation, the corresponding values are 2127.62 m^3/fed. or 50.66 cm with a seasonal rate of 2.6 mm/day for a growing season of 193 days.

Abbas *et al.* (1995) reported values of seasonal CU for Egyptian clover (Berseem) which ranged between 42.25 to 81.42 cm at Giza (middle Egypt) for two seasons and from 43.75 to 83.29 cm at Shandaweel (upper Egypt) for the same respective seasons.

Fresh yield (ton/fed.):

Regarding the effect of dry cultivation on Berseem fresh yield, results shown in Table (4) indicate that the highest yield was obtained from treatment A_2 i.e. by applying irrigation water till 5.0 cm above soil surface under the dry cultivation. In addition, data show a general trend for increasing the crop yield by increasing the availability of soil moisture in the effective root zone. Statistical analysis illustrated that the fresh yields were significant for the four cuts in the two seasons of study. Also, data reveal a slight difference in yield obtained from treatments A_3 and A_4. The mean values of fresh yield in the two growing seasons are 34.75, 36.9, 32.75 and 31.65 metric ton/fed for A_1 through A_4, respectively. On the other hand, for the wet cultivation in the two seasons,. B_2 gave the highest yield and B_4 gave the least. The mean values of fresh yield for B_1, B_2, B_3 and B_4, are 35.05, 37.6, 34.05 and 33.35 ton/fed., respectively.

The interaction effect of cultivation method and irrigation amount on fresh yield of Berseem was not significant. The mean values of both cultivation methods are presented in Fig. (2). It could be advisable to cultivate Berseem using the dry cultivation method. This method is effective in management of Berseem watering. These results are in agreement with those reported by Donovan and Meek (1983) and Abbas *et al.* (1995).

Crop-water efficiencies:

Crop water efficiency is a parameter which indicates the crop water productivity and this function could be evaluated in the two terms of efficiencies as water use efficiency (WUE) and water utilization efficiency (WUtE). These evaluation parameters assess the exerted efficiency in producing crop yield from water. The water use efficiency (WUE) indicates that amount of yield obtained from a unit volume of water consumed by plants, while the water utilization efficiency (WUtE) represents the amount of yield given by a unit volume of water applied to plants.

Regarding the effect of dry cultivation on water utilization efficiency (WUtE), results show that A_2 have the highest overall of 17.89 kg/m^3 (Table 5). The values of WUtE could be arranged in the descending order as; 17.89, 17.74, 17.7 and 16.83 kg Berseem/m^3 for A_2, A_1, A_3 and A_4.

Table (4): Fresh yield (ton/fed.) of Egyptian clover as affected by agricultural methods and irrigation treatments in the two growing seasons.

Season	Cut.	Date of	Treatments: Dry cultivation A_1	A_2	A_3	A_4	Wet cultivation B_1	B_2	B_3	B_4	L.S.D. 0.05	0.01	S.E.D
First season	1	Jan. 1/2004	5.80	6.1	5.4	5.2	6.1	6.9	6.0	5.6	0.66	0.93	0.3
	2	Feb. 15/2004	8.5	9.7	8.7	8.5	8.9	9.7	8.8	8.6	0.83	1.16	0.38
	3	Apr. 1/2004	10.7	11.1	10.1	9.7	10.8	11.0	10.5	10.4	0.67	0.94	0.31
	4	May 12/2004	8.6	8.9	8.0	7.7	8.7	9.3	8.1	7.6	0.50	0.21	0.23
Seasonal yield			33.60	35.80	32.2	31.1	34.50	36.90	33.40	32.20			
First season	1	Jan. 4/2005	6.7	7.0	6.1	5.9	6.3	7.1	6.1	6.3	0.85	1.19	0.39
	2	Feb. 19/2005	9.1	10.1	8.7	7.9	8.7	10.0	9.6	9.7	1.31	1.84	0.60
	3	Apr. 4/2005	11.0	11.3	10.4	10.1	11.7	11.5	10.7	10.5	0.69	0.96	0.32
	4	May 10/2005	9.1	9.6	8.1	8.3	9.5	9.7	8.3	8.0	0.80	1.13	0.37
Seasonal yield			35.90	38.00	33.30	32.20	35.6	38.3	34.7	34.5			
Average			34.75	36.90	32.75	31.65	35.05	37.60	34.05	33.35	Means are not sig. at the 5%		

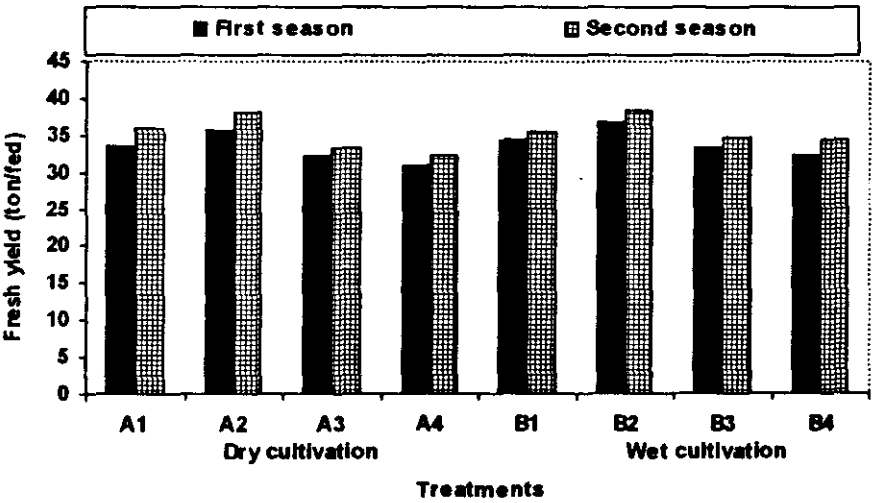

Fig. (2): Mean values of fresh yield (ton/fed) as affected by cultivation method and irrigation treatments. see notes of Fig. 1 for treatment description.

Concerning the effect of wet cultivation, treatment B_3 has the highest mean value of 17.21 kg/m^3. The values of WUtE could be arranged in the descending order as, 17.21, 16.59, 16.40 and 16.37 kg Berseem/m^3 for B_3, B_1, B_4 and B_2. Comparing the two cultivation methods, values of WUtE were higher under the dry than the wet method for the same level of watering. The parameter of WUtE is a function of the yield as nominator and applied water s dominator.

Table (5): Water utilization efficiency for Egyptian clover as affected by* agricultural methods and irrigation treatments in the two growing seasons.

Treatment	Dry cultivation				Wet cultivation			
	A_1	A_2	A_3	A_4	B_1	B_2	B_3	B_4
	Season 1 (2003-2004)							
W.UtE, kg/m^3	18.03	16.82	17.96	17.51	16.65	15.70	16.71	16.35
	Season 2 (2004-2005)							
W.UtE, kg/m^3	17.45	18.95	17.44	16.15	16.53	17.04	17.70	16.44
	Means of 2 seasons							
W.UtE, kg/m^3	17.74	17.89	17.7	16.83	16.59	16.37	17.21	16.40

* See footnote of Table 2.

Thus, by decreasing both applied and consumed water which associated with the dry cultivation, a higher value of WUtE could be obtained. The highest value 17.89 kg/m^3 resulted from A_2 which represents irrigation till water reaches 5.0 cm above soil surface. Accordingly, one kg of Berseem needs about 56 L of water under the dry cultivation, and 58 L of water under the wet cultivation. Abbas *et al.* (1995) found that optimum irrigation efficiency (expressed as kg/cm depth of water applied) increased under dry method than the wet method.

Water use efficiency (WUE, kg/m^3):

Regarding the effect of dry cultivation, water use efficiency (WUE, kg/m^3) for A_4 has the highest overall of 18.57 kg/m^3 (Table 6). The values of WUE could be arranged in descending order as 18.57, 18.43, 17.04 and 15.91 kg Berseem/m^3 for A_4, A_3, A_1 and A_2, respectively .

Concerning the effect of wet cultivation, treatment B_4 has the highest mean value of 17.83 kg/m^3. Values could be arranged in descending order of 17.83, 17.53, 16.38 and 15.26 kg/m^3 for B_4, B_3, B_1 and B_2. Comparing the two cultivation methods, it is clear that the values of WUE were higher under dry than that of the wet method for the same level of watering. The parameter of WUE is a function of the yield. The highest value 18.57 kg/m^2 resulted from A_4 of the dry method which representing watering with pan evaporation. Therefore, one kg of Berseem needs about 54 L of water under the dry method, while, it needs 56 L of water under the wet method.

Table (6): Water use efficiency for Egyptian clover as affected by *agricultural methods and irrigation treatments in the two growing seasons.

Treatment	Dry cultivation				Wet cultivation			
	A_1	A_2	A_3	A_4	B_1	B_2	B_3	B_4
	Season 1 (2003-2004)							
W.UtE, kg/m^3	16.39	15.34	18.99	18.91	15.84	14.49	18.02	17.85
	Season 2 (2004-2005)							
W.UtE, kg/m^3	17.68	16.48	17.86	18.23	16.92	16.02	17.04	17.80
	Means of 2 seasons							
W.UtE, kg/m^3	17.04	15.91	18.43	18.57	16.38	15.26	17.53	17.83

* See footnote of Table 2

SUMMARY AND CONCLUSION

Dry cultivation method for the Egyptian clover (Berseem), [which occupies almost one third of the winter cultivated area] may have some advantages as compared with the wet method. There were 4 treatments of the amounts of watering; they were (1) replenish the exhausted soil water by the growing plants based on soil moisture depletion (S.M.D), (2) watering till 5.0 cm above soil surface; (3) using the equation of Ibrahim (1981) of north Nile Delta and (4) the evaporation of Pan equation. These 4 irrigation treatments were assessed under the two methods of cultivation (dry and wet methods).

The main findings may be summarized as follows:

1. Almost the same yield was produced under the two methods. The average values are 34.00, 35.00 ton/fed. i.e. no difference in green or marketable yield was obtained.
2. Saving irrigation water of an amount of about 145 m^3/fed. (which would be 360 million m^3 at the national level).
3. Maximization of crop yield could be obtained either from one m^3 water as consumed (WUE) or applied (WUtE) with values of 1.94, 1 and 1.94, 2.1 kg/m^3 under dry and wet cultivation, respectively.
4. The seasonal applied irrigation water for dry method was 1961.25 m^3/fed. (46.69 cm), while it was 2106.47 m^3/fed. (50.15 cm) for the wet method.
5. Seasonal CU of Berseem under the dry cultivation was 46.22 cm with rate of 2.4 mm/day. The corresponding values for wet were 50.66 cm with rate 2.6 mm/day.

It might be concluded that the dry method could replace the wet method giving almost the same yield (34.5 ton/fed.). The national saving water expected from the dry cultivation of 360 million m^3 could cultivate a new land of about 500,000 fed (based on 7.000 m^3/fed. as annual water needs).

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الزراعة الجافة كوسيلة فعالة فى إدارة رى البرسيم

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معهد بحوث الأراضى ــ مركز البحوث الزراعية

اقيمت تجربتان حقليتان فى المزرعة البحثية بمحطة البحوث الزراعية بسخا بمحافظة كفرالشيخ لمنطقة شمال الدلتا خلال موسمى النمو ٢٠٠٣/٢٠٠٤ ، ٢٠٠٤/٢٠٠٥ على الترتيب. تهدف الدراسة الزراعة الجافة للبرسيم المصرى بدلا من الزراعة التقليدية الرطبه (اللمعه) أوالزراعة المبتلة كطريقة فعالة فى توفير المياه حيث خضعت كلا من طريقتى الزراعة لكميات مختلفة من ماء الرى والتى حسبت على أساس الاستنفاذ الرطوبى والرى حتى ٥ سم فوق سطح التربة بجانب طريقتان تعتمدان على البخر وهما معادلة ابراهيم والخاصة بشمال منطقة دلتا النيل ووعاء البخر وقد أوضحت النتائج ان الزراعة الجافة للبرسيم تحقق الأتى: توفير المياه بحوالى ١٤٥م^3 للفدان والتى تساوى ٣٦٠ مليون م^3 على المستوى القومى بالاضافة ان نفس المحصول قد تحصل عليه مثلما هوفى الزراعة المبتلة.

العائد المحصولى من وحدة المياه المضافة أوما يعرف بكفاءة الإضافة (W.Ut.E) كانت ١٦,٧٥ ، ١٦,٦٤ كجم/م^3 فى طريقتى الزراعة الجافة واللامعة على الترتيب. بينما العائد المحصولى من وحدة المياه المستهلكة للطريقتين هما ١٧,٥٤ و١٧,٤٩ كجم/م^2 مستهلك على التوالى.