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EFFECT OF BIO AND MINERAL FERTILIZATION ON NAKED BARLEY UNDER RAINFED AND SUPPLEMENTAL IRRIGATION CONDITIONS AT MATROUH AREA, EGYPT

El-Metwally, El-M. A.[1]; N. M. M. Moselhy[2]; E. A. Esmael[1] and M. A. Abd El-Aziz[2]

1- Agronomy Department, Faculty of Agric., Cairo University

2- Plant Production Dept., Ecology and dry Agric., Desert Res. center.

ABSTRACT

Two experiments were carried out during the 2006/07 and 2007/08 winter seasons at El- Hammam area, Matrouh, Egypt to investigate the influences of supplemental irrigation (SI) and fertilization package (FP) under rainfed conditions on productivity of naked barley (*Hordeum vulgare* L.). Each experiment included 28 treatments which were; four amounts of supplemental irrigation (SI) i.e. SI_0): rainfed only; SI_1): 60 mm/ fad; SI_2): 90 mm/ fad and SI_3): 120 mm/ Fad. and seven fertilization packages (FP) treatments i.e. FP_0): without fertilization; FP_1): Bio-N; FP_2): 20 Kg N/ Fad. + 7.5 Kg P_2O_5/ Fad. + 12 Kg K_2O/ Fad.; FP_3): 20 Kg N/ Fad. + 7.5 Kg P_2O_5/ Fad. + 12 Kg K_2O/ Fad. + Bio-N; FP_4): 40 Kg N/ Fad. + 15 Kg P_2O_5/ Fad. + 24 Kg K_2O/ fad; FP_5): 40 Kg N/ Fad. + 15 Kg P_2O_5/ Fad. + 24 Kg K_2O/ Fad. +Bio-N; and FP_6): 80 Kg N/ Fad. +30 Kg P_2O_5/ Fad. + 48 Kg K_2O/ Fad.). Results showed significant differences among supplemental irrigation treatments in all the studied traits in both seasons. Also, results clearly showed that grain, straw and biological yields were increased by each increment in amount of water supply from 60 to 90 then to 120 mm/ Fad. in the two seasons. It is evident that grain yield increased by 23.0, 82.7 and 111.1 % and by 22.9, 81.7 and 110.8 % in the first and the second seasons, respectively, due to increase of the added water supply amounts from 60 to 90 then to 120 mm/ Fad. in respective order. Results indicated that FP_3 treatment application which included 20 Kg N + 7.5 Kg P_2O_5 + 12 Kg K_2O / Fad. + Bio-N gave the tallest plants, longest spikes, heaviest 1000-grain weight, as well as, the highest values of grain, straw and biological yields, as well as, water use efficiency compared to the other tried fertilization packages here in both seasons. It is evident that the positive response of naked barley plants was only to add 20, 7.5 and 12 Kg of N, P_2O_5 and K_2O/ Fad. in respective order, in addition to bio-N fertilizer as a package i.e. FP_3. Ultimately, to gain high productivity of naked barley economically, it could be adding SI by amount of 120 mm/ Fad. with applying FP i.e. 20 kg N/ Fad. +7.5 kg P_2O_5/ Fad. +12 kg K_2O + Bio-N/ Fad. could be recommended under rainfed conditions at El-Hammam area, NWC of Egypt.

Keywords: Naked barley, supplemental irrigation, fertilization package, rainfall precipitation, yield and its components.

INTRODUCTION

Naked barley (*Hordeum vulgare* L.) is considered one of the most important edible crops all over the world, ranking the second order after wheat concerning world- cultivated area and food production. It is a newly introduced food crops in Egypt to reduce food gap, especially it can be cultivated in the newly reclaimed areas out the old valley such as the Northwest coastal (NWC) zone of Egypt under rainfed and/ or supplemental irrigation conditions.

Many investigators found significant differences among naked barley varieties in growth characteristics, yield attributes and grain yield under different edaphic and climatic conditions (Abo-Shetaia *et al*., 1994; Assey *et al*, 1990; and Abdel-Hamid and Mohamed, 2002)

Water supply is often the most critical limiting factor for growth and yield of cereal crops in rainfed areas and the most expensive input for irrigated crops. The rainfed areas of the Northwest coast (NWC) of Egypt are characterized by harsh agro-ecological conditions. The major constraint for cereal production under rainfed conditions in NWC region is the insufficient soil moisture content in the root zone to meet crop water requirements. Periods of severe water stress are very common and often coincide with the most sensitive stages of growth. Therefore, if supplied water through supplemental irrigation applied in adequate amount and at suitable time can enhance crop yield potentiality. The amount and timing of supplemental irrigations are to provide enough water during the critical growth stages to ensure optimal crop yield in terms of yield per unit of water (Oweis 1997; Abu-Awwad and Kharabsheh, 2000; and Milad, 2006). Sprinkler irrigation is considered to be the most suitable method for supplemental irrigation. However, Abu-Awwad (1998) reported that supplemental irrigation through blocked-end furrows significantly increased grain and straw yields of barley compared to supplemental sprinkler irrigation.

Under low rainfall precipitation (120-150 mm/ year), nitrogen fertilizers are some often effective when applied at sowing, but with high rainfall, split applications between sowing and up to the early booting stage can also increase grain yield and protein percentage (Mason, 1975). However, recovery of applied nitrogen by dryland wheat crops is commonly less than 50 percent (Fillery and Mclnnes, 1992), thus making economic returns risky in some situations. At Tel-Hadya, Syria, the optimal response of wheat to nitrogen fertilizer increased from 50 Kg N / ha under rainfed conditions to 100 Kg N / ha under supplemental irrigation (Oweis *et al*, 1998).

Increasing nitrogen fertilizer levels significantly increased plant height, number of spikes/m^2 and number of grains/ spike as well as, grain and straw yields/ Fad. while 1000-grain weight was decreased by increasing N levels from 23 to 46 Kg N/ fad (Assey *et al*, 1990 and Cantero-Martinez *et al*, 2003). Meantime, Radwan and Wafaa (2009) reported that applying mixed nitrogen with bio-fertilizers i.e Rhizobactrin, Nitrobein and Mycorrhizae were positive effect for enhance yield and its components of barley. However, application of micro-nutrient mixture (Fe + Mn + Zn) caused significant increase in plant height, number of grains/ spike, harvest index, grain yield and biological yield of naked barley (Abdel-Hameed and Ashormillesy (2005).

To maximize barley productivity under rainfed conditions, it is essential to identify the promising supplemental irrigation and determine the optimum fertilization requirements that promote plant growth and improve grain and straw yields. So, this study aimed to determine the adequate amount of supplemental irrigation and the suitable fertilization package under rainfed conditions at El-Hammam area.

MATERIALS AND METHODS

Two experiments were carried out during the 2006/07 and 2007/08 winter seasons at El- Hammam area, Matrouh, Egypt to investigate the influences of supplemental irrigation (SI) and fertilization package (FP) under rainfed conditions on productivity of naked barley (*Hordium vulgar* L.). Each experiment included 28 treatments which were four amounts of

Table 1: Properties of supplemental irrigation (SI)

SI_0	rainfed only
SI_1	60 mm/ Fad.
SI_2	90 mm/ Fad.
SI_3	120 mm/ Fad.

Table 2: Properties of fertilization package (FP)

FP_0	without
FP_1	Bio
FP_2	20 Kg N/ fad + 7.5 Kg P_2O_5/ fad + 12 Kg K_2O/ Fad.
FP_3	20 Kg N/ fad + 7.5 Kg P_2O_5/ fad + 12 Kg K_2O/ Fad. + Bio
FP_4	40 Kg N/ fad + 15 Kg P_2O_5/ fad + 24 Kg K_2O/ Fad.
FP_5	40 Kg N/ fad + 15 Kg P_2O_5/ fad + 24 Kg K_2O/ Fad. +Bio
FP_6	80 Kg N/ fad +30 Kg P_2O_5/ fad + 48 Kg K_2O/ Fad.

This study aimed to investigate the effect of supplemental irrigation and fertilization packages on yield and yield components of barley.

Each experiment included 28 treatments, which were arranged in a split plot design in three replications. Supplemental irrigation treatments were allocated randomly in the main plots, while seven fertilization packages were distributed randomly in the sup-plots. Every sub-plot area was 42 m^2 (1/100 Fad.).

The sowing date was after the 1st effective rainfall precipitation on December 6 and 11 in the first and the second seasons, respectively. Where, seeds of naked barley (Giza 2000 cv.) at the rate of 30 Kg/ Fad. were drilled in rows distanced at 20 cm apart with 7 m length. Each plot included 30 rows i.e. the plot area was 42 m^2. Harvest was carried out on April 23 for both seasons.

Monthly rainfall precipitation as presented in Fig. (1). The amount of rainfall precipitated were 99.5 and 98.9 mm / year in the 1st and 2nd season, respectively. The experimental soil is loamy-sand in texture. Chemical properties of soil during both seasons as shown in Table (1).

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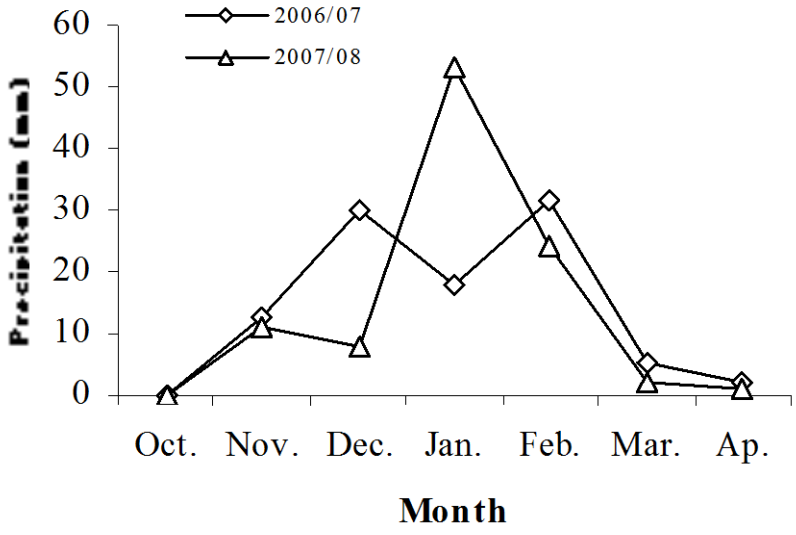

Fig. 1. Monthly rainfall precipitation (mm) in the two seasons of the study

Table 3: Chemical properties of experimental soil in the 2006/07 and 2007/08 seasons.

Sampling Depth (cm)	pH	E.c dsm^{-1}	Cat ions Na^{+1}	K^{+1}	Ca^{+2}	Mg^{+2}	Anions HCO_3^-	Cl^{-1}	SO^{-2}_4	$CO^{-}_{3}{}^{1}$
					2006/07					
0-15	7.67	0.60	3.35	0.56	0.50	1.25	0.54	4.16	1.10	--
15-30	7.72	0.62	3.24	0.55	0.58	1.19	0.53	4.18	0.85	--
					2007/08					
0-15	7.40	0.92	2.00	0.67	4.62	1.83	0.86	7.20	1.00	--
15-30	7.30	0.87	2.03	0.74	4.70	1.73	0.84	7.32	1.03	--

The used water for supplemental irrigation was saline groundwater (ranged from 2000 to 2500 ppm) pumped from a local well. Supply water was added through gated pipe irrigation system on equally three times, the first during the tillering stage, the second one was added at stem elongation stage while, the third one was added at heading stage of barley. The fertilization packages were added in one dose as soil application at sowing time. The used sources of mineral fertilizers of N, P and K were ammonium nitrate (33.5 % N), calcium supperphosphate (15.5 % P_2O_5) and potassium sulphate (48.5 % K_2O). Whereas, Microbin in rate of 400 gm/ seeds/ Fad. was used as bio-fertilizer mixed with seeds at sowing time. All other the recommended agricultural practices were applied as usual in barley fields under rainfed conditions.

At harvest time, ten guarded plants were taken randomly from each sub-plot to determine all yield attributes of naked barley, while, overall each sub-plot was used to determine grain, straw and biological yields. Water use efficiency (WUE) for grain production per mm of water was calculated. The collected data of the two seasons were subjected to proper statistical analysis of variance (Snedecor & Cochran, 1990) using M-STATC Program. Mean values were compared at P<0.05 using the Least Significant Difference (LSD) test. Economic analysis using partial budget was made according to Perrin, *et al* (1983).

RESULTS AND DISCUSSION

A. Effect of supplemental irrigation:

Results in Table 4 showed that plant height, number of spikes/ m^2, number of grains/ spike, as well as, grain, straw and biological yields were significantly affected by the tried supplemental irrigation treatments throughout the two seasons, the case was the same for spike length only in the first season and 1000-grain weight only in the second season. Also, water use efficiency (WUE) for grains production was highly significantly affected by supplemental irrigation treatments in both seasons. Moreover, results cleared that values of grain, straw and biological yields were increased by each increment in amount of water supply from 60 to 90 then to 120 mm/ Fad. in the both seasons. Superiority of high amount of water supply tried here may be attributed to its advantage in vegetative growth criteria i.e. plant height, number of spikes/ m^2 and number of grains/ spike and their contribution in maximizing such yield component values.

Table 4: Performance of supplemental irrigation concerning yield attributes of naked barley, as well as, water use efficiency (WUE) for grains during the 2006/ 07 and 2007/ 08 seasons.

Suppl. irrigation (SI)	Plant height (cm)	No. of spikes/ m^2	No. of grains/ spike	Spike length (cm)	1000-grain weight (gm)	Grain yield (Kg/fad)	Straw yield (Kg/fad)	Biological yield (Kg/ fad)	WUE (Kg grains /m3)
				2006/07					
SI_0	36.60	84.95	30.86	4.33	30.76	352.0	957.0	1309.0	4.05
SI_1	46.60	96.67	37.05	5.67	28.48	433.0	1534.0	1967.0	2.95
SI_2	52.00	110.40	43.90	6.29	31.10	643.0	1896.0	2539.0	3.63
SI_3	55.10	117.70	47.52	6.76	30.76	743.0	2757.0	3500.0	3.59
F. test	**	**	**	**	N.S	**	*	**	**
LSD 0.05	0.647	6.870	2.159	0.281	-	92.98	110.2	75.04	0.07
				2007/08					
SI_0	41.50	95.71	32.67	6.67	28.38	388.0	1055.0	1444.0	3.92
SI_1	53.10	105.10	40.00	6.84	26.62	477.0	1689.0	2167.0	3.00
SI_2	59.60	119.10	45.62	6.89	30.48	705.0	2089.0	2795.0	3.74
SI_3	63.00	127.90	60.29	7.12	24.62	818.0	3034.0	3852.0	3.74
F. test	**	**	**	N.S	**	**	**	**	**
LSD 0.05	0.852	8.363	3.564	-	0.898	74.93	84.98	78.57	0.05

**** and * : Significant at 0.01 and 0.05 levels of probability, respectively. N.S: not significant.**

The highest values of grain, straw and biological yields of naked barley were recorded by supplemental irrigation of the amount of 120 mm/ fad followed by 90 mm/ fad then by 60 mm/ Fad. in both seasons, but the lowest ones were obtained from check treatment (only rain without SI). Also, results indicated that there were no significant differences between SI treatments of 90 and 120 mm for WUE for grain production. It is obvious from results presented in Table (4) that grain yield increased by 23.0, 82.7 and 111.1 % and by 22.9, 81.7 and 110.8 % in the first and the second seasons, respectively due to increasing of the added water supply amounts from 60 to 90 then to 120 mm/ Fad. in respective order. It can be concluded that crop growth under rainfed conditions is poor and yield is consequently low, while, supplemental irrigation, using a limited amount of water, can lead to substantial improvement in yields and water use efficiency, especially if the water supply applied during the critical growth stages. These results are in harmony with those obtained by Oweis 1997; Abu-Awwad and Kharabsheh, 2000; and Milad, 2006.

B. Effect of fertilization packages:

Results in Table 5 showed that plant height, number of spikes/ m^2, number of grains/ spike, spike length and 1000-grain weight as well as grain, straw and biological yields were highly significantly affected by the tried fertilization packages (FP) in the two seasons. Moreover, results indicated that the applied FP_3 treatment which included 20 Kg N + 7.5 Kg P_2O_5 + 12 Kg K_2O / Fad. + Bio-N gave the tallest plants, more spikes/ m^2, more grains/ spike, longest spikes, heaviest 1000-grain weight, as well as, highest values of grain, straw and biological yields compared to the other tried fertilization packages here in both seasons. The case was the same for water use efficiency during both seasons. This fertilization package (FP_3) was followed by FP_5 treatment which included 40 Kg N + 15 Kg P_2O_5 + 24 Kg K_2O / Fad. + Bio-N in having the highest values of the abovementioned traits in the two seasons. However, the lowest values of yield and its attributes were recorded by the check treatment (without fertilization) in both seasons. Meanwhile, there were no significantly differences between applied FP_1 which included bio-N fertilizer only and FP_2 treatment which has 20 Kg N + 7.5 Kg P_2O_5 + 12 Kg K_2O / Fad. without bio-N fertilizer in plant height, spikes/ m^2, number of grains/ spike, spike length, as well as, grain, straw and biological yields in the two seasons. It is evident that the positive response of naked barley plants was only to add 20, 7.5 and 12 Kg of N, P_2O_5 and K_2O/ Fad. in respective order in addition to bio-N fertilizer as a package i.e. FP_3 when added during sowing date under the environmental conditions of experimental site. Under these conditions, adding of mineral and biological fertilizers with little amounts of nitrogen, phosphorus and potassium, as well as bio-N as a fertilization package may be became economically than adding higher amounts of one nutrient element alone. Generally, this could be due to the important role of NPK as essential nutrients in growth of cereals plants, and consequently increased photosynthetic capacity of plant and increased amounts of assimilates migrated to grains. Similar findings were reported by Milad, (2006); Radwan and Wafaa (2009).

Table 5: Performance of fertilization packages concerning yield ant its attributes of barley, as well as, water use efficiency (WUE) for grains during the 2006/ 07 and 2007/ 08 seasons.

Fertilization packages (FP)	Plant height (cm)	No. of spikes/ m^2	No. of grains/ spike	Spike length (cm)	1000-grain weight (gm)	Grain yield (Kg/Fad)	Straw yield (Kg/Fad)	Biological yield (Kg/ Fad)	WUE (Kg grains /m^3)
				2006/07					
FP_0	38.92	91.6	30.83	4.58	28.75	353.0	1427.0	1780.0	2.26
FP_1	43.08	96.2	36.83	5.08	30.92	474.0	1597.0	2070.0	3.09
FP_2	44.42	101.3	36.17	5.16	28.58	472.0	1615.0	2087.0	2.94
FP_3	55.50	111.9	48.00	7.00	31.33	724.0	2182.0	2907.0	4.84
FP_4	48.50	103.5	40.00	5.75	29.92	536.0	1770.0	2306.0	3.46
FP_5	52.67	107.9	44.50	6.58	31.17	642.0	2026.0	2669.0	4.30
FP_6	50.08	104.8	42.50	6.17	31.25	597.0	1887.0	2484.0	3.98
F. test	**	**	**	**	**	**	**	**	**
LSD, 0.05	0.749	7.624	2.799	0.498	1.75	77.7	126.2	92.80	0.06
				2007/08					
FP_0	44.00	100.6	34.83	5.97	25.50	386.0	1569.0	1954.0	2.28
FP_1	49.00	105.8	41.33	6.56	27.92	520.0	1762.0	2282.0	3.13
FP_2	50.80	111.0	40.83	6.52	26.00	520.0	1779.0	2299.0	2.99
FP_3	63.43	121.3	53.50	7.59	29.08	803.0	2398.0	3201.0	4.93
FP_4	55.00	112.7	44.50	6.84	27.08	588.0	1953.0	2541.0	3.49
FP_5	60.18	117.9	49.83	7.40	28.58	710.0	2229.0	2939.0	4.35
FP_6	57.08	114.3	47.67	7.29	28.50	656.0	2078.0	2735.0	4.01
F. test	**	**	**	**	**	**	**	**	**
LSD, 0.05	0.945	8.790	2.931	0.359	2.05	91.51	103.00	102.00	0.07

**** : Significant at 0.01 level of probability, and N.S: not significant.**

C. Effect of interactions:

The interaction between supplemental irrigation (SI) and fertilization packages (FP) had significant effect on grain, straw and biological yields in the two growing seasons as presented in Table 6. The obtained results indicated that naked barley plants which did not receive any additional water supply (only rain) were significantly affected by applying fertilization packages in grain, straw and biological yields traits in favor of FP_3 treatment (20 Kg N + 7.5 Kg P_2O_5 + 12 Kg K_2O / Fad. + Bio-N) followed by FP_5 treatment (40 Kg N + 15 Kg P_2O_5 + 24 Kg K_2O / Fad. + Bio-N). Also, the same trend was true under the rest of supplemental irrigation treatments in the two growing seasons. However, the highest values of yield traits were recorded by adding FP_3 treatment with supplemental irrigation of 120 mm/ fad (SI_3) followed by FP_5 treatment with the same amount of supplemental irrigation (SI_3) in the two seasons. While, the lowest of these values were recorded when the plants not received any mineral fertilizers or bio-N only in the case of rainfed irrigation (only rain).

At growth stages of cereal crops i.e. tillering, stem elongation and grain-filling are more sensitive to water deficit. These results were in harmony with those observed under rainfed conditions by Singh and Kumar, (1981); Oweis *et al* (1999), Turner (2004); Hamdy *et al* (2005) and Angas *et al* (2003). Ultimately, the highest grain yield of barley can be secure by adding supplemental irrigation with amount of 120 mm/ Fad. with applying fertilization package which included mineral and biological fertilizers i.e. 20

Kg N + 7.5 Kg P_2O_5 + 12 Kg K_2O / Fad. + Bio-N under rainfed and harsh environmental conditions.

Table 6: Grain, straw and biological yields of barley as affected by the interaction between supplemental irrigation and fertilization packages during the both seasons of the study.

Supplemental irrigation	Fertilization packages	Grain yield (Kg/Fad)		Straw yield (Kg/Fad)		Biolog. yield (Kg/Fad)	
		2006/07	2007/08	2006/07	2007/08	2006/07	2007/08
SI_0 (only rain)	FP_0	187.0	203.0	521.0	570.0	709.0	773.0
	FP_1	292.0	324.0	832.0	922.0	1124.0	1247.0
	FP_2	213.0	236.0	599.0	660.0	812.0	896.0
	FP_3	536.0	600.0	1548.0	1697.0	2085.0	2297.0
	FP_4	316.0	347.0	909.0	1007.0	1224.0	1353.0
	FP_5	485.0	533.0	1282.0	1414.0	1767.0	1947.0
	FP_6	434.0	475.0	1011.0	1118.0	1445.0	1593.0
SI_1 (Rain + 60 mm)	FP_0	311.0	340.0	1302.0	1432.0	1613.0	1771.0
	FP_1	402.0	442.0	1469.0	1615.0	1867.0	2057.0
	FP_2	347.0	381.0	1413.0	1559.0	1760.0	1940.0
	FP_3	587.0	655.0	1757.0	1927.0	2344.0	2582.0
	FP_4	428.0	470.0	1497.0	1651.0	1925.0	2121.0
	FP_5	484.0	535.0	1696.0	1867.0	2180.0	2402.0
	FP_6	472.0	520.0	1609.0	1772.0	2081.0	2293.0
SI_2 (Rain + 90 mm)	FP_0	452.0	494.0	1472.0	1619.0	1924.0	2113.0
	FP_1	576.0	631.0	1668.0	1840.0	2243.0	2471.0
	FP_2	641.0	703.0	1771.0	1953.0	2412.0	2657.0
	FP_3	783.0	865.0	2249.0	2474.0	3032.0	3339.0
	FP_4	655.0	720.0	1898.0	2091.0	2553.0	2811.0
	FP_5	720.0	792.0	2164.0	2383.0	2884.0	3176.0
	FP_6	671.0	736.0	2052.0	2263.0	2723.0	2999.0
SI_3 (Rain + 120 mm)	FP_0	463.0	505.0	2411.0	2653.0	2873.0	3157.0
	FP_1	625.0	684.0	2420.0	2669.0	3045.0	3353.0
	FP_2	687.0	759.0	2677.0	2945.0	3364.0	3704.0
	FP_3	991.0	1091.0	3174.0	3494.0	4165.0	4585.0
	FP_4	743.0	815.0	2780.0	3064.0	3523.0	3879.0
	FP_5	882.0	978.0	2961.0	3253.0	3843.0	4231.0
	FP_6	811.0	894.0	2874.0	3162.0	3685.0	4057.0
	LSD, 0.05	14.87	17.51	24.23	19.88	17.76	19.49

As illustrated in Fig. 2 and 3, it is indicated that water use efficiency for grain production was significantly affected by the interaction between supplemental irrigation and fertilization packages in both seasons of the present study. The highest values of WUE (6. 17 Kg grains/ m^3 and 6.06 Kg grains/ m^3) were resulted when FP_3 treatment was applied under SI_0 (rainfed treatment) during the first and second seasons, respectively. While, the lowest ones were recorded by FP_0 treatment when applied under rainfed treatment or SI_1 treatment without significant difference in both seasons. Meantime, the superiority of fertilization package (FP_3) was followed by FP_5 under water supply of SI_0 followed by SI_3 (120 mm) then SI_2 (90 mm) then SI_1 (60 mm) in respective order during the two seasons. It is evident that, each increment of water supply amount increased the efficient of water-use for grain production of naked barley, particularly when fertilization packages i.e. FP_3 and FP_5 were applied. except rainfed treatment, This was true in both

seasons as shown in Fig. 2 and 3. In this respect, Oweis (1997), Abu-Awwad and Kharabsheh, (2000) and Milad, (2006) reported that the amount of supplemental irrigation could be suitable to provide enough water during the critical growth stages of cereals to ensure optimal crop yield in terms of yield per unit of water.

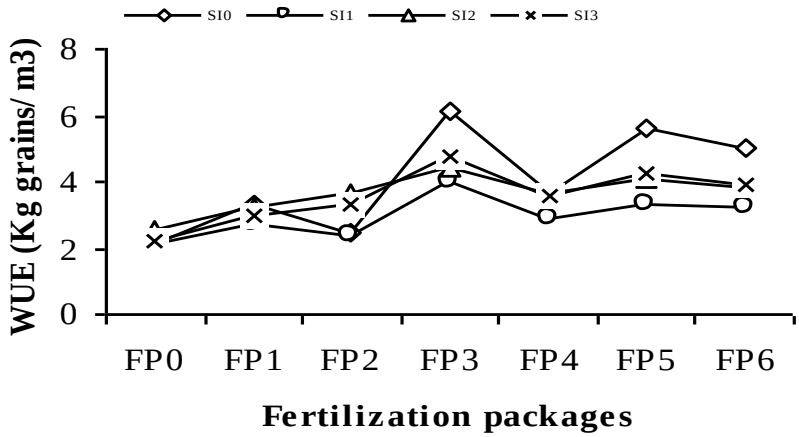

Fig.2. Water use efficiency for grain production as affected by interaction between supplemental irrigation (SI) and fertilization packages (FP) in the 2006/07 season

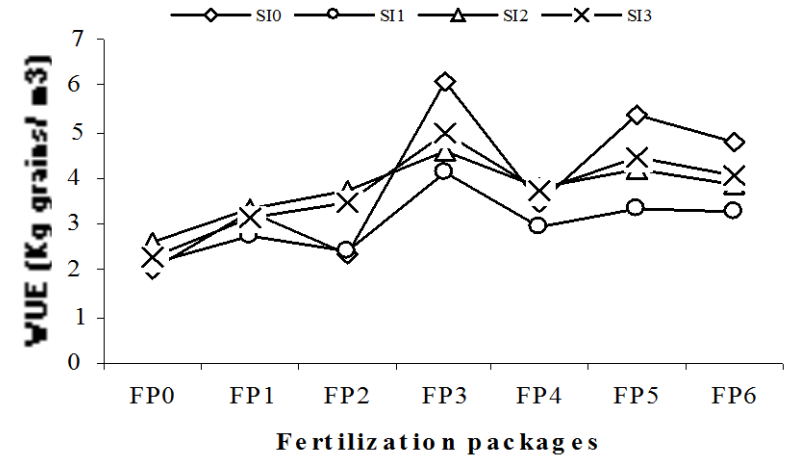

Fig.3. Water use efficiency for grain production as affected by interaction between supplemental irrigation (SI) and fertilization packages (FP) in the 2007/08 season.

D. Partial budget analysis:

Data presented in Table 7 showed that partial budget of naked barley was affected by the tried treatments of supplemental irrigation in the two seasons of the study. The highest values of gross return (GR) and net return (NR) were recoded by water supply amount of 120 mm/ Fad followed by 90 mm/ Fad then by 60 mm/ fad during the two seasons. However, the lowest values of GR and NR were recorded by rainfed treatment in both seasons. It is evident that each increment in amount of added water increased net return in favor of SI_3 (120 mm/ fad). These increases reached to 1122.0 LE/ fad and 1294.0 LE/ Fad in the first and second seasons, respectively (Table 7).

Table 7: Partial budget analysis as affected by supplemental irrigation during the 2006/07 and 2007/08 seasons.

Supplemental irrigation (SI)	2006/07			2007/08		
	Gross return (LE/Fad)	Total costs (LE/Fad)	Net return (LE/Fad)	Gross return (LE/Fad)	Total costs (LE/Fad)	Net return (LE/Fad)
SI_0	687.1	486.0	221.5	758.0	486.0	280.8
SI_1	970.2	536.0	434.2	1069.0	536.0	532.6
SI_2	1306.0	561.0	745.3	1437.0	561.0	876.1
SI_3	1708.0	586.0	1122.0	1880.0	586.0	1294.0

As shown in Table 8, results of partial budget analysis clearly indicated that gross return and net return (LE/ fad) were affected by different fertilization packages tried here in the 2006/ 07 and 2007/ 08 seasons. The variable costs differed according to price of each applied fertilization package and it was similar for two seasons. Meantime, the highest values of GR and NR were recorded by applying of FP_3 followed by FP_5 as compared with the lowest ones recorded by the first treatment without fertilization package. Gross return values resulted from applied FP_3 was reached to 1488 and 1641 LE/ Fad. in the first and second seasons, respectively, followed by FP5 which achieved 1351 and 1489 LE/ Fad. in the same order. The same trend was true in net return where, the highest values were 1012 and 1166 LE/ Fad. recorded by FP_3 followed by FP_1 that recoded 732 and 836 LE/ Fad. for the first and second seasons, in respective order.

Table 8: Partial budget analysis as affected by fertilization packages during the 2006/07 and 2007/08 seasons.

Supplemental irrigation (SI)	2006/07			2007/08		
	Gross return (LE/Fad)	Total costs (LE/Fad)	Net return (LE/Fad)	Gross return (LE/Fad)	Total costs (LE/Fad)	Net return (LE/Fad)
FP_0	582.0	286.0	566.0	934.0	286.0	647.0
FP_1	1032.0	300.0	732.0	1136.0	300.0	836.0
FP_2	1037.0	461.0	576.0	1142.0	461.0	681.0
FP_3	1488.0	475.0	1012.0	1641.0	475.0	1166.0
FP_4	1155.0	636.0	518.0	1271.0	636.0	635.0
FP_5	1351.0	650.0	701.0	1489.0	650.0	839.0
FP_6	1257.0	986.0	306.0	1384.0	986.0	413.0

Generally, water supply by amount of 120 mm/ Fad. as a supplemental irrigation and applying fertilization package of FP_3 which included 20 Kg N + 7.5 Kg P_2O_5 + 12 Kg K_2O / Fad. + Bio-N could be secured naked barley production economically.

Conclusion

The highest naked barley yields could be achieved by water supply in amount of 120 mm/ fad (504 m^3/ Fad.) which had been added during the three critical growth stages and adding 20 Kg N + 7.5 Kg P_2O_5 + 12 Kg K_2O / Fad. + Bio-N as fertilization package during sowing date of naked barley. Ultimately, water supply by amount of 120 mm/ Fad. as a supplemental irrigation and applying fertilization package of FP_3 which included 20 Kg N + 7.5 Kg P_2O_5 + 12 Kg K_2O / Fad. + Bio-N could be secured naked barley production economically under the adverse environmental conditions such as the experimental area at El-Hammam, NWCZ of Egypt.

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تأثير التسميد الحيوى والمعدنى على الشعير العارى تحت ظروف الزراعة المطرية والرى التكميلى بمنطقة مطروح- مصر

المتولى عبد الله المتولى[١]، نعيم مصلحى محمد مصلحى[٢]، عماد عبد الجواد اسماعيل[١] و محمود عبد السلام عبد العزيز[٢]

١) قسم المحاصيل- كلية الزراعة – جامعة القاهرة،

٢) قسم الإنتاج النباتي - شعبة البيئة وزراعات المناطق الجافة- مركز بحوث الصحراء.

أجريت تجربتان حقليتان تحت ظروف الزراعة المطرية بمنطقة الحمام شرق مدينة مرسى مطروح خلال موسمى ٢٠٠٧/٢٠٠٦ ، ٢٠٠٨/٢٠٠٧ على التوالى. وذلك بهدف دراسة تأثير التسميد الحيوى والمعدنى والرى التكميلى على انتاجية الشعير العارى. وكانت معاملات الدراسة كما يلى:

أ- معاملات الرى التكميلى (SI): أربع معاملات هى:

(SI_0): رى مطرى فقط ، (SI_1): ٦٠ مم/ فدان، (SI_2): ٩٠ مم/ فدان ، (SI_3)١٢٠: مم/ فدان.

ب- معاملات الحزم السمادية (FP) : سبع معاملات هى:

(FP_0): بدون تسميد – (FP_1): تسميد حيوى فقط (ميكروبين بمعدل ٤٠٠ جرام تخلط بتقاوى الفدان)- (FP_2): ٢٠ كجم ن/ فدان + ٧ كجم فو٢ أ٥ /فدان + ١٢ كجم بو٢أ /فدان – (FP_3):٢٠ كجم ن/ فدان + ٧ كجم فو٢ أ٥ /فدان + ١٢ كجم بو٢أ /فدان + حيوى –(FP_4): ٤٠ كجم ن/ فدان + ١٥,٥ كجم فو٢ أ٥ /فدان + ٢٤ كجم بو٢أ /فدان – (FP_5): ٤٠ كجم ن/ فدان + ١٥,٥ كجم فو٢ أ٥ /فدان + ٢٤ كجم بو٢أ /فدان + حيوى – (FP_6):٨٠ كجم ن/ فدان + ٣٠ كجم فو٢ أ٥ /فدان + ٤٨ كجم بو٢أ /فدان.

أظهرت النتائج ما يلى :

- كان هناك اختلافات معنوية بين معاملات الرى التكميلى فى كل من الموسمين. وقد أعطت معاملة الرى التكميلى باضافة ١٢٠ مم / فدان أعلى انتاجية لغلة المحصول والقش والمحصول البيولوجى فى كل من الموسمين، بينما سجلت معاملة الرى المطرى فقط أقل قيم للمحصول ومكوناته خلال موسمى الدراسة.
- أظهرت معاملات التسميد أن حزمة التسميد (FP_3) والتى احتوت على ٢٠ كجم ن/ فدان + ٧ كجم فو٢ أ٥ /فدان + ١٢ كجم بو٢أ /فدان + تسميد حيوى تفوقا معنويا حيث أعطت أعلى انتاجية لمحصول الشعير العارى وبعض مكوناته تلاها فى ذلك حزمة التسميد (FP_5) والتى احتوت على ٤٠ كجم ن/ فدان + ١٥,٥ كجم فو٢ أ٥ /فدان + ٢٤ كجم بو٢أ /فدان + تسميد حيوى. فى حين أن المعاملة بدون تسميد قد أعطت أقل القيم للمحصول ومكوناته فى كل من الموسمين.
- أظهر التفاعل بين معاملات الرى التكميلى ومعاملات الحزم السمادية أن أعلى غلة من الحبوب والقش والمحصول البيولوجى أمكن الحصول عليها عندما أضيفت الحزمة السمادية (FP_3) تحت ظروف الرى التكميلى باضافة كمية ماء بمعدل ١٢٠ مم / فدان. وأن كل زيادة فى كمية مياه الرى التكميلى أدت الى زيادة كفاءة استخدام المياه لانتاج الحبوب فى كل من الموسمين.
- لقد تفوق معاملة الرى التكميلى (١٢٠ مم/ فدان) اقتصاديا على باقى المعاملات, حيث سجلت أعلى قيمة من صافى العائد، كما تفوقت معاملة التسميد (FP_3) اقتصاديا ايضا على باقى الحزم السمادية ,حيث سجلت أعلى قيم لصافى العائد.
- توصى هذه الدراسة أهمية الرى التكميلى بالكميات المناسبة من الماء المتاح للرى خلال المراحل الحرجة لنمو نباتات الشعير العارى حيث يمكن التوصية باضافة ١٢٠ مم/ فدان والتى تشجع على اضافة الاسمدة المعدنية والحيوية فى صورة حزمة سمادية كما فى المعاملة (FP_3)التى من شانها تحسين الانتاجية تحت ظروف مناطق الزراعة المطرية كما هو الحال فى أراضى زراعة الشعير بمنطقة الحمام بمطروح.

قام بتحكيم البحث

أ.د/ أحمد أبو النجا قنديل — **كلية الزراعة – جامعة المنصورة**

أ.د/ السيد حامد الصعيدي — **كلية الزراعة – جامعة طنطا**