Advances in Environmental Biology, 5(7): 1627-1631, 2011
ISSN 1995-0756

This is a refereed journal and all articles are professionally screened and reviewed

ORIGINAL ARTICLE

Evaluation of the Yield and Yield Components Stability Wheat under the Influence of Various Irrigation Levels

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ABSTRACT

For the purpose of studying the effect of various levels of irrigation on the yield and yield components of wheat, an experiment was performed in a farm in the agriculture years (2008-2009) in the plain of Marv Dasht, Rashmijan region. Considering the importance of producing wheat in the plain of Marv Dasht and also the downfall level of stagnation in this region and the drought circumstance of the recent years, implementing the above experiment in Marv Dasht which is a fine example of atmospheric factors and good irrigation management for wheat production, seemed valuable. The experiment was carried out in randomized complete block design. The treatments where included of: 4 treatment including 4 irrigation levels I1 , I2, I3 and I4 in order and respective to the equivalent irrigation with the normal irrigation in the area, irrigation with 20% tension in the irrigation round, irrigation with 40% tension in the irrigation round and without irrigation (dry farming) which took place three times in the farm. The water used for irrigation in attendances I1, I2, I3 and I4 are measured as 503, 434, 395, 121 millimeters each. The result showed that an increase in the irrigation period by 20% and 40% in relation to the normal times in the area, eliminated the last irrigation rote and reduced the water usage for irrigation by 14% and 21%, which also reduced the seed's yield by 18% and 50% as well as reducing the yield of straw wheat by 27% and 47%. In addition the data analysis showed that lack of wheat irrigation in MarvDasht and planting this herb in a dry farming manner, reduces the yield of the seed and straw wheat to 82% and 83%.

Key words: Irrigation, water tension, yield, wheat.

Introduction

Over a period of time the lack of attention to the necessity of productivity and protection of water resources has created conditions where by water resources on earth are exposed to destruction and destroy, whereby water crisis is now a worldwide issue.

The most important and current environmental tension is drought and the tension caused by it which has brought limitations to agricultural products worldwide. The word drought used in agriculture is referred to a situation whereby the amount and distribution of rainfall is very little during the year which results in the yield of the agricultural plant being reduced [17]. On the other hand Kramer has defined drought as the lack of taking or lack of moisture inside the root which results in damage to the product [15].

By the end of the season, during various times of wheat growth the water tension usually results in decline of the seeds yield [16].

Depending on the phonology process of the plant which will face drought tensions, the yield of wheat seed parts will be under influence in a different way or form [14].

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Some research has shown that there's a positive and meaningful relationship in the yield of wheat with biological yield, between the 1000 kernel weight and the numbers of kernel in spike whereas it has no relation with the plant height and the harvest index [10].

A survey in the city of Gorgan regarding the relationship between grain yield components in irrigated conditions indicated that the 1000 kernel weight of has the most impact on its yield and growth [4].

It has been observed that in cases where soil moisture is adequate, the number kernel/spike has the most affect in its' production, and through drought conditions, the number of seeds in each spike or sometimes the average seed weight have equal share with the number of kernel /spike in the total yield [12,9].

Zyayian reviewed and reported crop irrigation with four schedules deducting the available and usable soil moisture based on 30%, 50%, 70% and 90%, whereby soil moisture reduction with irrigation based on 70% contained the highest yield and efficient water usage [11].

In a study in Fars province Imam and colleagues reported that the maximum and minimum yield of wheat based on 30% irrigation on water evacuation of available water and 90% irrigation on water evacuation of available water are respectively equal to 6747 and 3852 kilograms per hectare achieved [2].

In separate studies Pirooz Niya and colleagues [3] Zare Feiz Abadi and Ghodsi [7] reported that the seed yield in wheat is subject to the number of spike per area unit, number of seeds per spike and the 1000 kernel weight [7,3].

Danaiee and Ayeeneh [5] looked at the effects of cutting of the last water supply and also the last two water supplies on eight types of wheat in Behbahan where they reported the effect of irrigation cuts meaningful and significant to wheat's yield, whereby the highest seed yield was with the rate of 721 / 4 tons per hectare in full irrigation mode and the least yield was with 400 / 3 tons per hectare in the state of cutting off the last two water supplies. The highest seed yield belongs to Chamran and the mutual irrigation effects and figures were reported significant [5].

To determine the sensitivity of Mahdavi wheat to moisture stress, Assadi and colleagues [1] performed an experiment in Karaj, with nine treatments and four replication. The treatments included full irrigation in all stages of growth, no irrigation and irrigation at different growth stages. Maximum yield was attained with full irrigation and minimum yield was where there was no irrigation treatment. As well as the above conclusion, the results also showed that in terms of seed yield, between the different treatments (different amounts of irrigation water) at 5%, there was significant difference noticed [1].

In the research project on Wheat in Fars province, Ramezan Pour and Dastfal [6] performed three irrigation treatments according to water requirements, 25 and 50 percent reduction in irrigation water to an optimized run on ten varieties of wheat. The results showed decrease of 25 and 50 percent water, respectively reduces seed growth by 8/21 and 7/40 percent. Also, indicators of biological functioning were respectively reduced by 4/16 and 2/32 percent [6].

Salemi and Afyouni [8] did a study to investigate the response of different varieties of wheat to different low irrigation treatments in Isfahan with three irrigation treatments, respective of irrigation rates 100, 80 and 60 percent evaporation and aspiration of the product was conducted and Concluded that the effect of different levels of irrigation on seeds yield, biological yield, plant height, 1000 kernel weight and number of kernels /spike are significant and meaningful by 1%, but the influence of the above scale on the number of kernel in spike and on its' characteristics for harvest, have no meaning or significant [8].

While studying the effects of different drought stress treatments, Guetna and colleagues, Zhong Hu and Rajaram found out that the number of kernel in spikelet and the number of kernel in plant, show the greatest sensitivity to drought stress. While the 1000 kernel weight of relatively before flowering due to the second or further transfer of stored nurtured material does not have much sensitivity [18,13].

Materials and methods

This research took place in the agriculture years (2007-2008) in the plain of Marvdasht by the area of Rashmyjan. Considering the importance of producing wheat in the plain of Marv Dasht and also the downfall level of stagnation in this region and the drought circumstance of the recent years, implementing the above experiment in Marv Dasht which is a fine example of atmospheric factors and good irrigation management for wheat production, was considered valuable. The land to be tested has longitude 52 degrees and 85 minutes east and latitude 29 degrees and 87 minutes north which is situated 5 km to the east side of Marvdasht with 1534 m altitude above sea level in neighborhood of Rashmijan village.

After land preparation (plow and disk) on the 25 octobr 2007, Wheat (Chamran) was planted by grain drill machine. The experiment took place in complete randomized block designs. Treatments were: irrigation I1, I2, I3 and I4 respectively equivalent to the usual round of irrigation area, irrigation with 20% stress in irrigation scheduling, irrigation with 40% stress in irrigation scheduling and no irrigation (rain fed) which was repeated three times and conducted under field conditions. The Kurt dimensions were considered to be 8x4 meters and their distance from each other was 1 meter. The source of irrigation was a well with a depth of 120 meters with an output rate of approximately 15 liters per second, which would lead water through pipelines to several meters away from the Kurt. There after the water would be driven through streams to the appropriate Kurt for irrigation. At the mouth of the intended Kurt for irrigation, a device called flume W.S.C four was installed to measure the amount of time for irrigation and subsequently the scale of water usage for each plot. The farmer was then responsible to cut off the water when needed.

Irrigation with different levels of stress or indeed delay in irrigation was applied. Finally, irrigation water consumption for treatments I1, I2, I3 and I4 are respectively equal to 503, 434, 395 and 121 mm.

After harvesting the wheat plant some parameters were left to evaluate the effect of drought stress on crop plants such as: number of tillers in square meter, the number of spike per square meter, total number of seeds per square meter, plants' weight, straw weight in square meter, plants' height, leafs' flag weight, spike's length, seeds' yield and biological yield were measured. To measure the parameters above, 1 square meter was harvested from the centre of each plot. All existing numbers of tillers in 1 square meter were counted. Then from the tillers of each plot, 40 random samples were selected and the parameters of plant height and spikes' length were measured. Then the samples were dried in oven for about 24 hours where the temperature was 100 degrees Celsius and the remaining parameters were measured.

Results and discussion

Statistical analysis of wheat yield in Table 1 shows the effect of different irrigation regimes on parameters of number of spikes in square meter, the number spikelet in spike, the number of kernel in spike, the total number of spikelet in square meter, the total number of kernels per square meter, 1000 kernel weight, weight of dry straw, grain yield, straws yield, biological yield, plant height, leafs' flag weight and spike length at 1 percent was significant. The only nonsignificant figure was the harvest index.

Comparison of average yield and yield components under different irrigation regimes in Table 2 show that in terms of the number of spike per unit area treatments I1 and I2; I2 and I3; I3 and I4 are in one group. With regards to the number of spikelet in spike, treatments I2 and I3 are in one group and the other two treatments are placed in two separate groups instead.

Also about the number of seeds in spike, treatments I1 and I2 are in one group and the two others are in two different and separate groups. Also in regards to the total number of spikes in surface level, the averages were completely different. The total number of seeds per unit area was also the status of this species. In terms of the 1000 seed Weight of treatments I1 and I2; I2 and I3 were treated in one group, and I4 was put in another group. Looking at the weight of dry straw I2 and I3 were placed in one group and the other two were each in two separate groups.

In the case of grain yield, treatments I1 and I2 are in one group and the two other treatments were placed in two other separate groups. With regards to straw yield, treatments I2 and I3 were in one group and treatments I1 and I4 each belonged to two separated groups. Biological functions in each of the treatments were put in separate groups, which mean that in terms of statistics, they have each had different average. The harvest index in all four treatments was placed in one group which means that there is lack of difference in average and that the irrigation regimes had nonsignificant effect on them. Plant heights in each of the treatments were placed in separate groups.

Considering the weight of the leaves' flag, treatments and I2 I3; I3 and I4 were placed in one group and treatment I1 was treated in a separate group. Also regarding the height of spike in unit area, the two treatments I2 and I3 were placed in one group whereas the treatments I1 and I4 were placed in two quite distinct groups.

Statistical analysis of correlation coefficients between grain yield and yield components indicate that most influence on grain yield is respectively the total number of seeds per unit area, average plant height per unit area and dry straws' weight per unit area, respectively possess correlation coefficients (r = 0.98), (r = 0.97), (r = 0.1996).

1000 seed weight possesses the lowest correlation with correlation coefficient (r = 0.45). In this context, Imam and colleagues [2] showed that in drought conditions, the number of spikes per square meter is (r = 0.751) and the biological yield with (r=0.707) have the highest correlation with grain yield, while where the conditions are favorable, the highest correlation with grain belong to the number of kernel in spike which is equal to(r = 0.864) and biological yield of (r=0.848).

Statistical analysis of correlation coefficients between straws' yield and the yield components of straw shows the most influence on straw yield per unit area are number of spikelet's in area unit and weight of flag leaf respectively with correlation coefficients (r = 0.95), (r = 0.94), (r = 0.1993). The average of spikes' length with correlation coefficient (r = 0.77) has the lowest influence.

In the end, the statistical analysis of yield components on biological yield effects indicate that most influence are respectively by the weight of dry straw per unit area, the total number of grain per unit area and average plant height with correlation coefficients in order of (r = 0.99), (r = 0.97), (r = 0.1996). Also the least impact is with1000 kernel weight with has correlation coefficient of (r = 0.45).

Amounts of water in treatments I2, I3 and I4, I1 compared to treatment I1 in order of 69, 108 and 382 millimeters has decreased by 14, 21 and 76 percent. The impacts of these values on the components yield have been this way. Number of plants in treatments I2, I3 and I4 compared to treatment I1 has been reduced in order of 20, 38 and 49 percent. The average number of spikelet in square meter in treatments I2, I3 and I4 compared to treatment I1 has been reduced as 2168 30, 48 and 67 percent. The average number of spikelet in one spike has been reduced in treatments I2, I3 and I4 compared to treatment I1 as follows 13, 16 and 32 percent.

For the average number of kernel in spike, treatments I2, I3 and I4 have been reduced compared to treatment I1 by 4, 31 and 58 percent. Total number of kernels per square meter on treatments I2 and I3 compared to I1 in order of 23, 57, and treatment I4 has been reduced by 80 percent. The 1000 kernel weight has increased in I2 and I3 treatments compared to I1 by 7, and 15 percent, and decreased on treatment I4 by 18 percent. The weight of dry straw in square meter in treatments I2, I3 and I4 has been decreased compared to I1 treatment by 27, 47 and 82 percent. Average height of plants in square meter in treatments I2, I3 and I4 has again been decreased compared to I1 by 10, 29 and 58 percent.

Weight of flag leaf's per square meter in treatments I2, I3 and I4 has been reduced compared to I1 by 37, 63 and 90 percent.

The average spike length per square meter in treatments I2, I3 and I4 has been reduced compared to I1 by 13, 18 and 35 percent.

Wheat yield on the basis of kilograms per hectare in treatments I2, I3 and I4 has been decreased compared to I1 by 1010, 2787 and 4592 kg equal to 18, 50 and 83 percent. Yield of wheat straw on treatments I2, I3 and I4 has been reduced compared to I1 by 1743, 3049 and 5357 kilograms equal to 27, 47 and 82 percent.

Biological function on treatments I2, I3 and I4 has been reduced compared to I1 by 2753, 5835 and 9949 kilograms equal to 23, 48 and 82 percent and finally the harvest index on treatments I2, I3 and I4 has increased by 5% compared to I1 and 2 decreased 2 percent.

According to the analysis of data obtained, it can be concluded that increasing the amount of irrigation intervals by 20 and 40 percent compared to typical district irrigation, which removed the last irrigation turns and reduced the amount of irrigation water consumed by 14 and 21 percent, has respectively caused a decrease of 18 and 50 percent seed functioning and 27 and 47 percent wheat straw yield.

Also the data analysis showed that non-irrigated wheat plants grown in the region of Marvdasht and dry planting them, will cause reduction on seeds yield and wheat straw respectively by 82 and 83 percent. Hence, in case of drought and drought tension in Marvdasht region, we can approximately predict the reduction of wheat yield with respect to the amount of irrigation water consumption and irrigation scheduling.

Table 1: The statistic results of yield and yield components analysis of wheat in agricultural years 2007-2008.

Average of the squares															
Spike weight Cm/m^2	Leaf flags weight g/m^2	Plant height Cm/m^2	Harvest index %	Biological yield t/ha	Straw function t/ha	Seed yield t/ha	Dry straw weight g/m^2	1000 kernel g/m^2	Total number of grain in m^2	Nnumber of spike in m^2	Nunmber of seeds in spike	Number of spikelet in spike	Number of spike in m^2	*fd*	S.O.V
1.28	37.23	10.82	0.0002	0.64	0.21	0.116	2116.6	27.76	873091.5	14.88	1.9	27642.6	4950.5	2	Repeats
2.99**	577.03**	1050.4**	0.001n.s	54.68**	15.29**	12.29**	152811.09**	65.86**	100946.4**	189.87**	8.77**	12507.8**	43199.3**	3	Irrigation treatment
0.12	33.35	6.501	0.001	1.72	0.74	0.32	7461.9	2.136	3077210.02	9.42	0.28	301695.04	3569.2	6	faults
0.94	0.9	0.98	0.29	0.94	0.91	0.95	0.91	0.95	0.94	0.91	0.94	0.95	0.86		correlation

The symbols * and **are meaningful in levels 5 and 1 percent and 'ns' symbolizes insignificant.

Table 2: The average comparison of yield and yield components under effects of experimental factors in agricultural years 2007-2008.

Spike weight Cm/m^2	Leaf flags weight g/m^2	Plant height Cm/m^2	Harvest index %	Biological yield t/ha	Straw function t/ha	Seed yield t/ha	Dry straw weight g/m^2	1000 kernel g/m^2	Total number of grain in m^2	Nnumber of spike in m^2	Nunmber of seeds in spike	Number of spikelet in spike	Number of spike in m^2	Experimetal Factors Irrigation treatment
6.91a	35.96a	72.86a	45a	12.04a	6.5a	5.54a	650.52a	33.84b	16448a	7181.13a	29.427a	12.87a	557.67a	I_1
5.98b	22.81b	65.847b	45a	9.29b	4.76b	4.53a	476.19b	36.063ab	12601b	5013.06b	28.293a	11.2367b	446.67ab	I_2
5.67b	13.16bc	51.86c	46a	6.2c	3.45b	2.75b	345.66b	38.90a	7035c	3722.56c	20.22b	10.8367b	344.67bc	I_3
4.49c	3.72c	30.42d	48a	2.09d	1.14c	0.94c	114.81c	27.867c	3375d	2384.7d	12.343c	8.7133c	284.33c	I_4

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