The Effect of Different Irrigation Regimes on The Growth Process of The Reproductive and Vegetative growth Traits of the Aerobic Rice Genotypes in the northern region of Khuzestan (Iran)

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Abstract

The study was carried out and planned to determine the effect of different irrigation regimes on the growth process of the area and weight Leaf also the number of florets and panicle weight in the aerobic rice and also determining the variety of the genotypes florets of it at Khuzestan province (Iran) for two years (2014-2015). Four irrigation regimes (For 1-, 3-, 5- and 7-days interval) are placed in the main split-plots and 12 genotypes of rice in the sub-split plots by 3 repetitions. The results of the combined analysis show that there was a significant difference in all traits between genotypes, irrigation regime and the mutual effect of two factors on the level of one percent. Two irrigation regimes of the one-day and three-day intervals have the maximum value and the seven-day irrigation regime has the minimum value in the accumulation of the food material for all the traits in terms of less time. The grain yield had the highest value in the second irrigation regime and IR 81025-B-327-3 genotype with the average of 6555.10 kg for per hectare, and in addition it had the greatest positive and significant correlation (0.506**). The study of the trait's growth process showed that all genotypes reached to their maximum growth by reducing the irrigation cycle in a less time and we observed the time reduction in the reproductive phase that had the least positive change in the last two weeks in terms of the grain's sterility in this interval. As well as some types of this plant with the low-resistance, reduced 49% and 21%, respectively, and they were with more severe in terms of the dry weight of panicle and the number of florets in comparison of the conventional irrigation regime which can be called it as a mechanism to escape from the drought.

Keywords: Growth process, intervals, irrigation, Vegetative growth.

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INTRODUCTION

Rice is one of the oldest practices of cultivating agricultural crops (Ghosh and Chakma, 2015). This crop has been cultivated in the large parts of the world as one of the most important crops and it is the food crops for more than half of the world's people (Park et al., 2014). Drought is one of the most serious threats in the world that might emerge at any time during the growing season and it can damages the successful production of the crops (particularly for the rice). Therefore, one of the major challenges in the agriculture is to produce more food with less water (Tuyen and Prasad, 2008). About 70 percent of the 25 percent of the world's available fresh water is used in the agricultural part and 25 to 30% of this water is dedicated to the cultivation of the rice (Sedaghat et al., 2015). Rice has the highest rate of the water consumption among the agricultural crops and it includes about 80% of the overall consumable fresh water resources in Asia (Sedaghat et al., 2015). Near to 75% of the world's rice is produced in irrigated rice paddies (Karmelina et al., 2011). The air exchanging between soil and atmosphere will be possible by the 'Alternate Wet/Dry Irrigation (AWDI)' technique (Tang et al., 2005). The plant root system will have the adequate oxygen by the multi-days irrigation that carried out once in every few days that this process lead to accelerate the mineralization of the organic materials in the soil and nitrogen fixation and all these items increase the vegetative nutrients in the plants and, consequently, increasing the growth of them (Dang et al., 2012; Tan et al., 2013). The lack of moisture is one of the most important factors for restricting the growth process (Mosavy et al., 2016). The intermittent irrigation management can provide the plant's requirements in the critical situations (Shanmugasundaram and Helen, 2015). The main advantage of the rice intermittent irrigation with multi-days intervals of the irrigation cycle is to save the water consumption (Uphoff et al., 2013) and also reducing the amount of chemical fertilizer in terms of the reduction in the leaching process (Chowdhury et al., 2014). Limouchi states "decreasing the growing season of the varieties is the effective factor for reducing the yield in terms of reduction of non-structural carbohydrates' transmission into the main sink (meaning the grain). He emphasized also about the positive significant correlation between grain yield and the panicle weight (0.626**). Although the growth rate of the crops affects the rice grain yield at each growing phase, but its rate has critical impact on the final yield of the rice in the last two weeks before panicle formation; thus, to maximize this value is one of the management and modification objectives to achieve the optimum grain yield during this critical period (Limouchi et al., 2014). Modifying the cultivating techniques is an effective strategy to increase the quantitative and qualitative growth rate (Farrell et al., 2004) that the irrigation regimes could be an appropriate alternative. Although the growth rate of the crops affects the rice grain yield at each growing phase, but its rate has critical impact on the final yield of the rice in the last two weeks before panicle formation; thus, to maximize this value is one of the management and modification objectives to achieve the optimum grain yield during this critical period (Horie et al., 2003). Although there is a requirement to produce high yielding varieties, but the capacity of the tension tolerance must be considered in the local varieties of the crops (Wu et al., 2011). The drought tension leads to decrease the relative water storage of the plant which is supposed to keep it fresh and firm (Xu et al., 2013). The severe decrease in the available water for the multi-days irrigation regimes lead to the negative impacts on the plant and will reduce vegetative growth, particularly in seedling stage, (Salehifar et al., 2014). The supplemental irrigation can present a manageable alternative to reduce the negative aspects of the terminal drought (End of season) at the reproductive stage (Nehbandani et al., 2016). On the one hand, the drought and the irrigation regimes with a much more intense of the plant tolerance, lead to disorder in the reproductive stage and also the lack of proper transferring and allocation of the carbohydrates and sugars in the grains that in turn it leads to increase the grain yield and the growth parameters of the rice (Durand et al., 2016; Mohd Zain and Razi Ismail, 2016); on the other hand the permanent flood irrigation will lead to decrease the growth of the plant for various reasons such as the cost of aeranchyma formation, and, consequently, the high correlation of the growth process parameters with the grain yield lead to decrease the economic crop of the rice plant (Abdola and Zarea, 2015). The present study was carried out to investigate about the effects of the various irrigation systems on Morpho-physiological of the growth process of the vegetative and productive traits, the yields of the varieties of the rice with the purpose of identifying and investigating the physiological reaction of the possible or sensitive mechanisms for the water-short conditions and the flood irrigation traits through examining the change process of the mentioned traits, the positive role of the traits that can play in enhancing the period of the plant growth and increasing the grain yield and also providing the functional traits to improve the genotypes of the rice cultivation.

MATERIALS AND METHODS

This research was conducted to reduce and optimize water consumption and improve irrigation efficiency by the split plots with two factors and three repetitions and forming the completely randomized block designs through the dry planting method in 3×4 plots for two years (2014-2015) at the farm site of the Shavoor Agricultural Research Station that associated to Iran Agricultural and Natural Resources Research center. The farm site is located at the 70 km away from the north of Khuzestan in the region between Karkhe and Karun rivers, with the latitude of 31 degrees and 50mins and longitude of 48 degrees and 28mins and 33m height from the sea. The texture of the farm soil was loam-clay in the optimum pH range (5.7 to 7), with electrical conductivity of 5.2 µS/cm and the amounts of the nitrogen, phosphorous, and potassium were respectively 0.09%, 10-12%, 120% and 2.5 ppm (part per million). Four irrigation regimes were located as the subplots, including one-day or controlled interval (common in the region), and three-day, five-days and seven-days interval as the main plots and 12 rice genotypes (Table 1) was located in the sub-plot. The dry seeds of each genotype were prepared by a planter from Hamadan for planting in the 20 cm rows and irrigation regimes were applied in the middle of the process. The plots were watered up to the 5 cm height with a pump which supplied and controlled water and then the irrigation was stopped. This process was applied throughout the growing season for all four irrigation regimes. To prevent the penetration of the water into adjoining plots, all mounds and the walls of the furrows were covered by the plastic foil in the depth of 1meter into the soil. The type of irrigation regime was selected based on the conditions and potential of the water and the amount of the water, which should run into the plots was measured based on the height of the water and the size of the plots during about 7 hours of irrigation according to the water flow allocated by the pump. Some meteorological parameters are shown in Table (2). To provide the necessary mineral nutrients, the nitrogen was supplied via the urea fertilizer in the amount of 200 and 300 kg in per hectare as the 25% of grade fertilizer (20-25 days after flowering) and the 75% of it was used with three phases of 25 percent in the three times of supervision; respectively, the bud cluster formation (35-40 days after using the grade fertilizer), the beginning of fertility (30-35 days after the first supervision), and the emerging the clusters (panicles). The phosphorus fertilizer in 50 kg per hectare, the potassium fertilizer from the triple superphosphate in 100 kg per hectare and the zinc from the sulfate fertilizer in 40 kg per hectare were used and fed as the main soil. The Integrated weed management was conducted by weeding and using the 2-4-D pesticide with a dose of 1.5-2 liters per hectare (35-40 days after flowering). The studied traits include the average total the leaf area, average total leaf dry weight, Panicle weight and total number of florets. Final grain yield was measured once in the 5-day intervals after 25 days of the inauguration of the growth. 30 plant samples were analyzed and observed on average in this period to study the changes and modification processes and the role of these properties in the final crop yield and the impacts of the various irrigation regimes.

When 85% of seeds were fully ripe flowers in the cluster, the harvest got on the 1.5 square meters of the middle of each plot with removing the margins in order to measure grain yield with 14% moisture.

Table 1- Some features and used genotypes' pedigree in the study

Genotype		Cross	Origin	Drought Tolerance
V_1	VANDANA	C 22/KALAKERI	INDIA	1
V_2	IR 78908-193-B-3-B	VANDANA/IR 65	IRRI	1
V_3	IR 81429-B-31	IR 78908-44/IR 78908-86	IRRI	1

V_4	IR 78875-176-B-1-B	PSB RC 9/IR 64	IRRI	3
V_5	IR 79971-B-202-2-4	VANDANA/WAYRAREM	IRRI	5
V_6	IR 80508-B-194-4-B	PSB RC 9/AUS 257	IRRI	7
V_7	IR 80508-B-194-3-B	PSB RC 9/AUS 257	IRRI	5
V_8	IR 79907-B-493-3-1	IR 55419-04/IR 64	IRRI	5
V_9	IR 81025-B-347-3	NSIC RC 140/IR 74371-3-1-1	IRRI	5
V_{10}	IR 81025-B-327-3	NSIC RC 140/IR 74371-3-1-1	IRRI	3
V_{11}	NADA	$AMOL_3$/SANG TARAM	IRAN	3
V_{12}	TARUM	-	IRAN	9

Table 2- Average of minimum and maximum of monthly temperature (planting to harvesting) in Shavoor Agricultural Research Station for two years (2014 and 2015)

				(2014)				(2015)
Month	Mean	Min. (°C)	Mean	Min. (°C)	Mean	Min. (°C)	Mean	Min. (°C)
Jun.		26		44		26.6		46.2
Jul.		27.8		46.7		27.8		45.7
Aug.		27.8		46.5		29.1		47.5
Sep.		25.2		44.5		27.4		44.6
Oct.		21		38		22.2		39.5
Nov.		12.7		29		15.8		27.8
Average		23.42		41.45		24.82		41.88

The SPSS statistical software was used to test the normality of the data from the random sampling. The variance and correlation analysis were carried out by using the SAS and SPSS software after ensuring the normality of the data and the mean of the data was compared to a probability level of 5% through the Duncan test. The diagrams were drawn by using Excel software.

RESULTS AND DISCUSSION

Leaf area: In fact, this trait is the average total leaf areas that include the flag leaf and other leaves. This trait indicates to the vegetative growth during the growing season and its positive and negative roles which can supply the photosynthesis materials for the sink (grain). The results of the combined analysis showed apart from the year mutual effect in the irrigation regime in the levels and effects, there is a significant difference between two or three factors of them simultaneously in the level of one percent (Table 3). The comparable means showed by reducing the amount of irrigation, the leaf area is reduced and the IR 81025-B-347-3 genotype with an average of 31.396 square centimeters had the highest leaf area (Table 4 and 5). The result, as we expected is due to the reduction of the turgor and the dehydration phenomenon in the leaf that finally, the leaf area was reduced by reducing the angle of the V-shaped cells. Other studies (Mosavy et al., 2016) had similar results in terms of reducing the leaf area in the moisture scarcity condition based on the recent reasons.

As it can be seen in Figure 1, in all varieties, the most of the leaf area was related to the first irrigation regime, but in all four irrigation regimes, the leaf area was reduced by over time and the highest decrease in the leaf area was observed under the flood irrigation regime. It can be concluded from the recent results that the development rate of the leaf and increasing the amount of the leaf area had been in the first irrigation regime in all genotypes more than any other irrigation regimes before emerging the cluster due to the relative optimum condition. In other irrigation regimes, the reduction gets a slower slope or remained unchanged. It seems that this sharp decline in the leaf area in the first irrigation regime is more than other irrigation regimes due to achieving to the turgor maximum and given that the permanent flood irrigation and other various reasons such as leaves falling and wilting them arising from asphyxia and the high irrigation stress and also given that these genotypes are aerobic, especially during reproductive growth period and reversibility potential. Aside from the genetic potential, the value of the low-resistance genotypes resulted in a decrease among the genotypes of the plant, but the reduction was much less in the high-resistance genotypes. Given that the first irrigation regime that had a weak operation with having the maximum leaf area index than the second and third irrigation regimes and according to the Limouchi et al., (2013), it can be concluded that having a higher leaf area is a prerequisite for further corps, but it is not enough and we can justify this issue, given that the final results of genotypes. The grain yield is affected by the other features such as the net photosynthesis rate and the crop growth rate and most importantly, the harvest index, so that sometimes having the excessive leaf area could reduce the net photosynthesis rate and crop growth rate and it could have an adverse effect on the harvest coefficient (Dong et al., 2012, Tan et al., 2013). The second irrigation regime had more crops, while it had less maximum leaf area index. So, it can be prevented the degradation of chlorophyll and leaf fluorescence phenomenon in hot conditions such as Khuzestan by having less total leaf area index through the smaller leaves but with the vertical arrangement. The leaf area could avoid from the overheating and excessive sweating by reduction of the sunlight received in the leaf area unit and maintaining the water potential of it. In turn, the occurrence of such phenomena leads to continue the leaf photosynthesis for a longer time in one day. Although the present results are not consistent with other studies of Tan et al., (2013), but they are consistent with Limouchi et al., (2013) about further reducing the leaf area for achieving the maximum growth potential. The effect of aging and disability and reduce the angle of the V-shapes cells lead to create a negative role for the leaf area due to the receiving the radiation, as a result, excessive sweating in the leaf area and eventually, degradation of chlorophyll and increasing the fluorescence. These phenomena prevent to continue the photosynthesis and also producing the photosynthetic materials in the regional conditions of the Khuzestan.

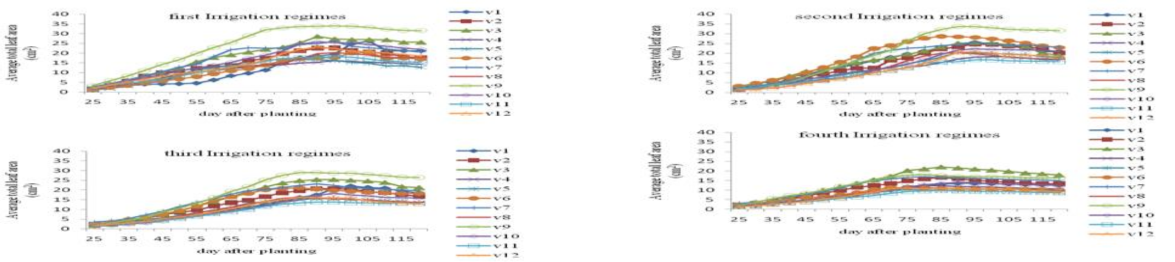

Figure 1- The change process of average total leaf area of rice genotypes in different irrigation regimes

Leaf dry weight (Average total leaves): The results of the combined analysis showed there is a significant difference in the level of one percent among the total main levels and the mutual effects of two or three factors between them (Table 3). Given that the comparable means (Table 4), the total leaf dry weight resulted in a decrease by reducing irrigation cycle, which can be conducted in the regimes with low irrigation intervals, as a result, there was more energy to increase the leaves and enhancing sunlight efficiency in order to supply photosynthetic material due to the optimum moisture conditions around the plant. So, it makes a positive effect on the increase of grain yield in these irrigated regimes (Limouchi et al., 2013). Among these genotypes, the changes were mainly about the reasons related to the genotypes, in such a way that genotype with an average of 0.180 g was the highest value and IR 79971-B-202-2-4 and TARUM genotypes jointly with an average of 0.076 g were the lowest value. To consider the pervious reason, the mutual effect of two factors showed that the highest and lowest amount with the average of 0.255 g and 8.576 g, that related to the IR 81025-B-347-3 genotypes in the first irrigation regime and NADA in the second irrigation regime respectively (Table 5). The obtained results are consistent with other studies (Durand et al., 2016; Mohd Zain and Razi Ismail et al., 2016 ;) about the genetic dependence of the genotypes' change and reducing the leaf weight in irrigation scarcity condition due to the reduction of the facilitation through the water in the allocation of the needed nutrients for growing the rice plant.

The change process of the leaf weight like other traits was at its greatest extent in the twenty days after the beginning of the cluster emerging and then its amount got a slower slope. Among the different irrigation regimes, the first irrigation regime had the most slop of the changes that it may be to reach the maximum leaf area due to the above explanations. As a result, the weight of the leaves resulted in an increase, while the leaf weight resulted in an increase in the irrigation regime with the longer interval with more rates to complete the vegetative cycle and they achieved to their maximum weight in a shorter time and then it became gentle and constant. The mentioned result is considered as a resistance mechanism to escape from the drought and this resistance mechanism has become more appearance in the sensitive genotypes and they reached to their maximum weight much sooner with higher resistance due to the higher and more tolerant than other genotypes. The aerobic genotypes, especially the types of genotypes with the high resistance have a structure that could adapt itself more to the drought conditions with minimal negative impact than the type's one with less resistance. The obtained results are consistent with other studies (Durand et al., 2016; Mohd Zain and Razi Ismail et al., 2016 ;) about the reduction of the dry leaf weight due the growth disorder in the water-short conditions at the reproductive stage and the lack of transfer and allocation of carbohydrates and sugars for increasing the weight of the leaves. But these results are not consistent with other research (Abdola and Zarea, 2015) about the negative effects of irrigation with short intervals, because, the cost of forming other resistance mechanisms such as aeranchyma reduces this trait instead of increasing the leaf weight (Figure 2).

The grain yield had the most positive and significant correlation with the relative traits with the leaf after the relative traits with the stem traits (plant length and peduncle length) that includes the leaf dry weight (0.476**) and leaf area (0.462**). The results of the study are consistent with other study (Limouchi et al., 2013) about the more impact of the sugar's allocation from the stem to the grain than the level of the grain yield (Table 6).

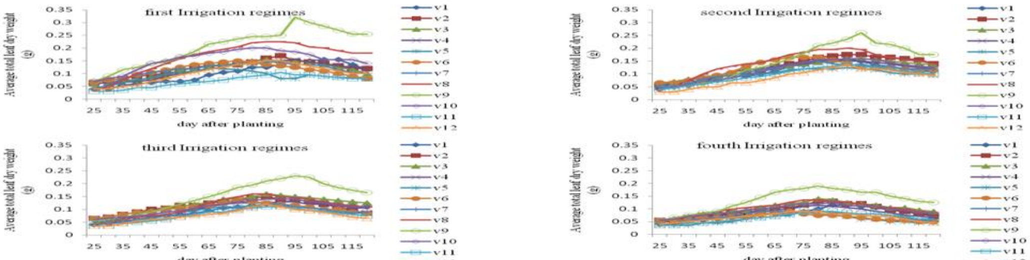

Figure 2- Change process of the total average dry weight leaf of the rice genotypes in different irrigation regimes

Panicle weight: The results of the combined analysis showed all main levels and the mutual effects of two and three factors between them have a significant difference at one percent level (Table 3). Given that the mentioned cause-effect relationships and its direct and high effect on increasing the yield, we need more research for breeding this trait. By observation of the comparison means table, the irrigation regime in the 3-days interval had the highest value and the irrigation regime in 7-days interval had the lowest value irrigation. As a result, it can be stated that the reduction of the growing season, especially the reproductive growth in the irrigation regime of 7-days interval was the major cause of these results. Among the genotypes, the IR 81429-B-31 genotype with the average of 3.020 g, had the most weight of the dry panicle in the second irrigation regime, which can be the result of the increasing length and more secondary divisions than other genotypes (Table 4 and 5). From flood irrigation to the irrigation regime of the 7-day interval, losing weight was much higher in the low-resistance genotypes, in such a way that in the low-resistance genotypes, losing weight = 48.96 g, in the high-resistance genotypes = 20.12 g and among all genotypes, it was 33.18 g, due to the less consistent of the low-resistance genotypes. The obtained results were consistent with other researches (Mosavy et al., 2016) about the reduction of the weight panicle with shortening the growing season and also in the severe water-short, because it has the lowest panicle weight due to the increase of dryness in the reproductive stage and more reducing this period in the irrigation regime of the 7-days interval that the growing season is shorter in it.

The panicle filling process indicates that the highest rate and period for an effective panicle filling related to the second irrigation regime and the fourth irrigation had the lowest rate and period for it. It seems that high sterility arising from the dehydration and the severe restriction of the demand for non-structural carbohydrates are the reasons for the low rate fillings in an effective period, weight panicle and harvest index in the fourth irrigation regime. As well as among the genotype, the IR 81025-B-347-3 genotype reached to the maximum weight of the panicle for the relative reasons of the genotype. The average rate of the panicle weight resulted in an increase under the flood irrigation, six days after the beginning of the panicle emergence and for the three other irrigation regime fourteen days after panicle emergence (The TARUM genotype had a delay by two days than two other genotypes). According to the results, in addition to the growth conditions of the plant, especially the crop growth rate (CGR) before the panicle emergence, there are also other affective factors such as the potential of the panicle and irrigation regime. In this regard, the effective grain filling period and its rate and creating the balance between them is very important. The obtained results are consistent with other reports (Durand et al., 2016; Mohd Zain and Razi Ismail et al., 2016) about the diversity of dry panicle weight in the cultivars and the genotypes of the rice and these results are also consistent with other research (Salehifar et al., 2014) about the presence or absence of the final and slow stages in the grain filling of the rice cultivars as well as they are consistent with other results (Mosavy et al., 2016) about the reduction of the panicle weight in excessive water-short condition (Figure 3).

The results of correlation showed also that the trait has a positive and significant correlation (0.429**) in one percent level with grain yield. The obtained results are consistent with another study (Limouchi et al., 2013) about the positive and significant correlation of the panicle weight due to the grain yield in the effective, main sink of assimilates for harvesting (Table 6).

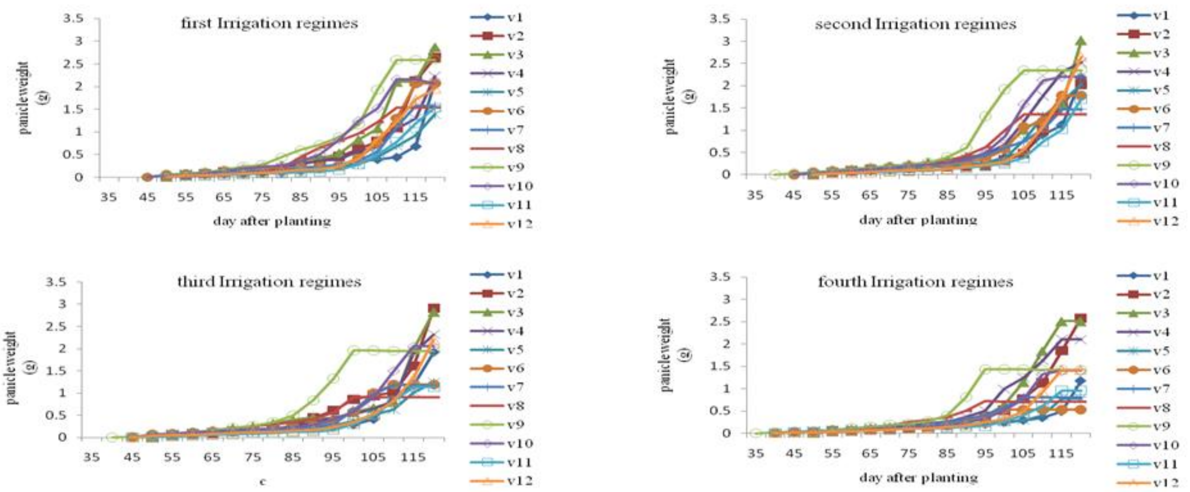

Figure 3- Changes process of dry panicle weight of the genotypes cultivars in the different irrigation regime

The number of floret the panicle: the number of grains in panicle is a key component of the grain yield in the rice. Regardless of physical location florets in the length of the panicle, their numbers may be affected by different irrigation regimes during the proceedings. The results also showed that among different irrigation regimes, genotype and the mutual effect were the two factors of significant differences in the level of one percent and they were no significant differences among the simultaneous effect of three factors; irrigation regimes, genotypes and year (Table 3). Among the different irrigation regimes, the number of florets per panicle resulted in a decrease process statistically from the first irrigation regime to the fourth one, and this reduction in the low resistance genotypes was 20.99 floret numbers per panicle, in genotypes with high resistance 18.40 floret numbers per panicle, and among all genotypes was 22.65 floret numbers per panicle that this reduction in the fourth irrigation regime in 7-days interval could be due to drought stress at the reproductive stage. So that as a result of the floret sterility, the assimilates were transferred to the root, instead of the grain, and the degree of the tested genotypes' compatibility is higher in the irrigation regime of the 3-days interval. Among the genotypes, the IR 81429-B-31 genotype had the highest number in the second irrigation with a three-day interval. Due to there are always the number of sterile florets for various reasons such as maintaining the balance and the lack of allocated photosynthetic material, therefore generating the optimum conditions and suitable management of this condition can be important to increase the number of grains. The results of the above statements are consisted with other reports of Shanmugasundaram and Helen, (2015) (Tables 4 and 5).

The most of changes were in the second irrigation regime with observing the number of florets in the panicle by examining the change process and the greatest number of the floret were in it, and this irrigation reached to its maximum growth with a greater rate than the other irrigation regimes. All genotypes reached to the maximum number of florets per panicle in 15 days after panicle emerging and then slope of the curve has been fixed due to the grain filling and the allocation of the assimilates. It has the greatest impact on increasing grain weight after this stage, and by improving the desired conditions by the management, the improvement of the increase of the grain weight will be possible. The difference between the various of the irrigation regimes in the genotypes with high resistance (VANDANA, IR 78908-193-B-3-B, IR 81429-B-31) was lower and more stable than other genotypes that indicates more effectiveness and sensitivity of the other genotypes to the different conditions of irrigation and yet it needs to apply better improvement of the management conditions given that to the different irrigation regimes (different drought conditions) in them (Figure 4). The obtained results are consistent with other study (Mosavy et al., 2016) based on the positive impression on increasing the irrigation cycle like the event occurred in the irrigation in 3-days interval given to the aerobic genotypes and not increasing too much water in the flood conditions which sometimes leads to water stress as well. And these results are inconsistent with others (Dong et al., 2012, Tan et al., 2013) that they stated "the reduction of the irrigation cycle in terms of increasing the atmosphere exchange and accelerating the mineralization of the organic matter have a positive influence for increasing the reproductive growth".

As it was expected the number of the florets in the panicle have a significant positive correlation (0.464**) with grain yield. Regarding to Limouchi statements, (2013), this trait showed more correlation than the total weight of the panicle (Table 6), given that to this fact which this trait forms the number of active sinks and as a result lead to our main and economic harvest.

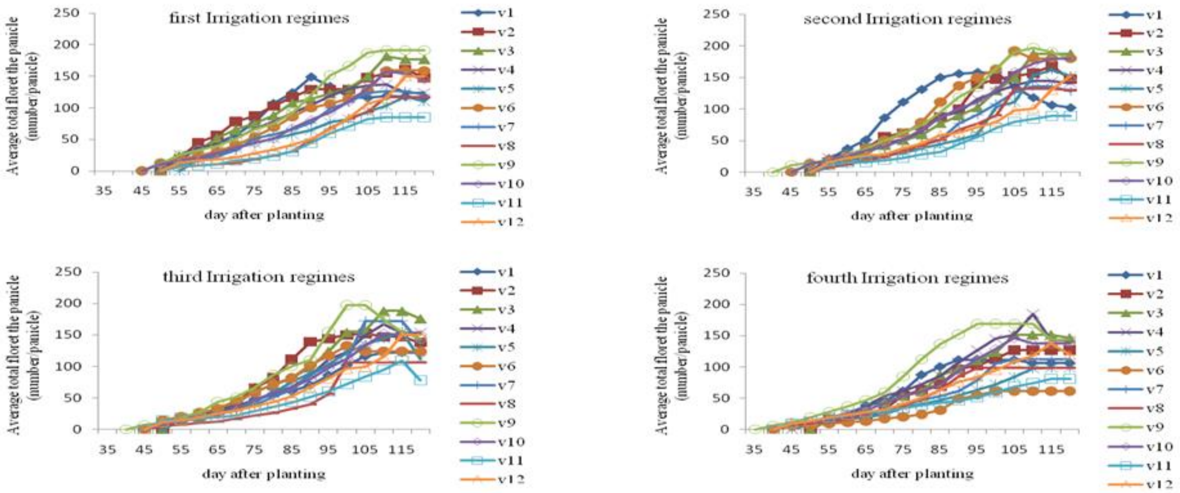

Figure 4- Change process in average of the florets number of the genotypes cultivars in different irrigation regimes

Grain Yield: According to the results of the combined analysis in the level of one percentage there was a significant relationship between the year, irrigation regimes, their mutual effect, as well as between genotypes and the mutual effect of the genotype in the irrigation regimes. But between the mutual effect of genotype in the year and the simultaneous effect of three factors, was no difference in terms of statistically and it shows that the grain yield is under the impact of the genotype features, the different irrigation regimes and their resultant of the positive convergence (Table 4). The mean comparison showed that the highest grain yield was related to the treatments of the second irrigation regime in 3-days interval and with an average 5094.31 kg per hectare that in comparison with the treatments of the flood irrigation regimes (Probably due to the lack of consistency and wasting the resistance energy like the energy that takes to get the aeranchyma and so on) and also the irrigation regimes of 5 and 7-days interval (it Could be due to the lack of facilitate to access the nutrients and accumulation of the assimilate at the base of the plant), its crops have increased, respectively, 19.50%, 10.72% and 34.21% equal to 993.52, 546.05 and 1742.79 kg /per hectare (Durand et al., 2016; Mohd Zain and Razi Ismail et al., 2016). The recent results, according to other statements (Tarlera et al., 2015; Sedaghat et al., 2015) indicate that the second irrigation regime in 5-days interval and in the lack of water conditions can be appropriate to increase the irrigation efficiency and also to reduce the environmental pollutants like the Methane. Besides, the permanent flood irrigation in addition to not being compatible with many investigated genotypes, it also leads to washing the nutrients and the lack of accessing the plant to these materials. It seems, given that with the reduction of the irrigation process, one of the reasons for reaching this conclusion is the different responses of the various vegetative stages due to the reduction of the irrigation process from the first treatment to fourth one that, in turn, it is due to the assimilate limit and reducing the period of filling and the grain growth (Table 4). Between the rice genotypes, the IR 81025-B-327-3 genotype was superior than the others that their highest amounts related to the second irrigation regimes with an average of 6555.10 kg per hectare. The compatibility and preferable reasons of this genotype are due to its escape from the water stress by reducing the plant height, especially in the maturity period of 10-20 cm range and as a result the allocation of more carbohydrates to the main sinks. The mutual effect of two factors showed in accordance with other studies (Tavala et al., 2015; Sarayloo et al., 2015) that the genotypes reflection to the various irrigation regimes was different, given that the threshold of their tolerance and the relative traits of different genotypes, in such a way that all genotypes in the fourth irrigation regime have the lowest grain yield (Table 5) due to the reduction of the length of growing season and thus to allocate less carbohydrates and the transferred minerals to the main sink, and ultimately reducing the activity of the sink and the capacity of the dry material accumulation of the grain (capacity of the grain × number of the grain). These results were consistent with other studies (Durand et al., 2016; Mohd Zain and Razi Ismail, 2016; Pandey et al., 2014) to reduce grain yield in terms of increasing the tension more than the tolerance threshold of the plant due to the growth disorder in the reproductive stage and the lack of transfer as well as allocation of carbohydrates and sugars in the grain. These results are consistent with the other study (Abdola and Zarea, 2015) but they are inconsistent with the study of Ghasemi-Nasr et al, (2016) that stated “increasing the available water of the stem in the flood irrigation conditions lead to increase the rice yield.

General Conclusion

The results showed generally, the reduction of the vegetative cycle that ultimately it is due to the reduction of opportunity for absorption of the nutrients that it leads to decrease in the amount and rate of these traits as the dominant defense mechanism to escape from the drought stress. Among the genotypes, the high resistant genotypes preserved better their growth process in terms of reducing the irrigation cycle and it was in a manner that the reproductive traits of the panicle dry weight and the number of florets between the low resistance genotypes have a significant reduction of 48.96% and 20.98% respectively, compared to the conventional irrigation regime. They reached to its maximum growth rate at a far less time and we witnessed the lowest positive change in the last two weeks of the mentioned irrigation regime due to the sterility of more grains in this limit period.

		MS				
S.O.V	df	Average total leaf area	Average total leaf dry weight	Panicle weight	Average total floret the panicle	grain yield
Year	1	1484.252**	0.0378**	1.037**	15749.040**	13560464.565**
Rep. (Year)(Error a)	4	23.023	0.0007	0.025	1453.991	989008.720
irrigation regimes	3	1116.259**	0.0419**	8.139**	20931.916**	39098649.286**
irrigation regimes Year×	3	0.772ns	0.0003**	0.002**	109.489ns	2585374.714**
Error b	12	0.687	0.0001	0.003	971.611	753853.818
Genotypes	11	368.339**	0.0205**	7.157**	15131.754**	9638043.784**
Year × genotypes	11	15.925**	0.0003**	0.006**	111.251ns	597461.724ns
× irrigation regimes genotypes	33	31.342**	0.0018**	0.457**	1644.117**	3136384.190**
irrigation regimes genotypes × ×Year	33	12.379**	0.0002**	0.003**	94.204ns	199931.307ns
Error c	176	1.041	0.0001	0.002	385.434	432662.206
C.V(%)	-	5.882	6.8063	2.494	14.338	15.39

Table 3- The brief of the combined analysis of the results related to the Morph-physiological traits of the rice genotypes

Ns, * and **: Nonsignificant and significant at 5 and 1% level of probability, respectively.

Table 4- comparing the average two-year of the Morpho-physiological characteristics of rice genotypes

Treatments	Average total leaf area (cm²)	Average total leaf dry weight (g)	Panicle weight (g)	Average total floret the panicle (number/panicle)	grain yield (kg/h)
irrigation regimes					

I1	20.370 a	0.122 a	2.047 b	148.149 a	4100.79 c
I2	20.217 a	0.123 a	2.110 a	152.114 a	5094.31 a
I3	16.814 b	0.101 b	1.820 c	132.812 b	4548.26 b
I4	11.975 c	0.071 c	1.368 d	114.596 c	3351.51 d
genotypes					
V1	18.141 d	0.104 d	1.843 f	117.963 f	3541.29 de
V2	16.790 e	0.104 d	2.542 b	140.328 cd	4303.04 b
V3	20.760 b	0.113 c	2.809 a	179.472 a	5025.67 a
V4	13.659 g	0.101 d	2.296 c	150.636 c	4091.79 bc
V5	13.194 g	0.076 g	1.361 h	118.473 f	3806.83 cd
V6	19.844 c	0.083 f	1.393 g	131.063 de	3528.29 de
V7	19.432 c	0.091 e	1.258 i	124.997 ef	4030.50 bc
V8	14.402 f	0.129 b	1.128 j	117.711 f	4843.87 a
V9	26.349 a	0.180 a	2.079 d	165.189 b	4899.18 a
V10	17.725 e	0.115 c	1.931 e	163.514 b	5085.33 a
V11	13.080 g	0.079 fg	1.336 h	90.694 g	3362.21 e
V12	14.751 f	0.076 g	2.059 d	142.971 c	4766.62 a

Means in each column, followed by at least one similar letter(s) are not significantly different at 5% probability level using Duncan's Multiple Range Test.

Table 5- comparing the average two-year of the Morpho-physiological characteristics of rice genotypes in the testing treatments

Treatments	Average total leaf area (cm^2)	Average total leaf dry weight (g)	Panicle weight (g)	Average total floret the panicle (number/panicle)	grain yield (kg/h)

irrigation regimes	genotypes					
	V1	20.990 e-h	0.115 d-g	2.100 h-j	116.257 k-q	2332.10 xy
	V2	17.365 h-o	0.121 c-f	2.640 c	148.372 f-j	4038.01 j-t
	V3	25.487 b-d	0.100 f-j	2.872 b	177.990 b-e	4551.67 d-n
	V4	14.325 m-r	0.115 d-g	2.230 fg	166.332 b-f	2949.50 u-x
	V5	12.570 q-v	0.080 j-n	1.391 pq	110.540 n-q	3541.83 o-w
I1	V6	28.721 ab	0.080 j-n	2.072 ij	159.132 c-g	4487.50 f-p
	V7	20.507 e-i	0.100 f-j	1.581 n	121.788 i-p	3559.83 n-w
	V8	17.446 g-o	0.180 b	1.530 no	135.596 g-n	4779.17 d-k
	V9	31.396 a	0.255 a	2.592 cd	191.170 b	4582.17 d-m
	V10	21.759 d-g	0.140 c	2.070 ij	185.776 bc	5233.67 c-g
	V11	15.274 k-q	0.080 j-n	1.530 no	114.107 l-q	3087.83 t-x
	V12	18.598 e-m	0.100 f-j	1.952 kl	150.724 e-i	6066.33 a-c
I2	V1	20.680 e-i	0.110 e-h	2.170 g-i	127.427 h-p	3531.67 o-w
	V2	20.043 e-j	0.140 c	2.032 jk	147.139 f-j	4479.83 f-p

	V3	18.729 e-l	0.135 cd	3.020 a	216.832 a	5361.17 c-f
	V4	16.556 i-q	0.120 c-f	2.531 d	141.040 f-m	5113.33 c-h
	V5	17.806 g-n	0.095 g-k	2.032 jk	152.124 d-h	4145.50 h-r
	V6	22.589 c-f	0.115 d-g	1.781 m	180.055 b-d	4128.01 h-s
	V7	22.806 c-e	0.120 c-f	1.471 op	128.120 h-p	5398.83 c-f
	V8	17.041 h-p	0.140 c	1.360 q	130.041 g-o	5530.33 b-d
	V9	31.412 a	0.175 b	2.352 e	181.437 bc	6362.55 ab
	V10	20.998 e-h	0.125 c-e	2.201 gh	180.031 b-d	6555.10 a
	V11	15.602 k-q	0.100 f-j	1.711 m	89.079 q-s	4501.50 e-o
	V12	18.338 f-m	0.095 g-k	2.661 c	152.043 d-h	6024.11 a-c
	V1	18.392 f-m	0.110 e-h	1.922 l	122.092 i-p	4379.17 g-p
	V2	16.414 i-q	0.085 i-m	2.912 b	138.125 f-n	4628.67 d-l
I3	V3	21.072 e-h	0.125 c-e	2.832 b	177.024 b-e	5378.06 c-f
	V4	13.231 o-t	0.105 e-i	2.321 ef	153.043 d-h	4978.66 d-j
	V5	13.480 n-t	0.085 i-m	1.241 r	112.109 m-q	3900.83 l-u

	V6	18.116 g-m	0.085 i-m	1.191 r	124.021 h-p	3628.16 m-v
	V7	19.603 e-k	0.090 h-l	1.170 r	138.044 f-n	4224.33 h-q
	V8	13.561 n-s	0.112 e-h	0.911 s	106.077 o-r	5405.33 c-f
	V9	26.236 bc	0.165 b	1.952 kl	145.009 f-k	5484.67 b-e
	V10	15.951 j-q	0.110 e-h	2.052 jk	150.148 e-i	5055.01 d-i
	V11	12.866 p-u	0.075 k-o	1.140 r	78.022 st	3147.67 s-x
	V12	12.843 p-u	0.065 m-q	2.201 gh	150.026 e-i	4368.66 g-p
I4	V1	12.503 q-v	0.080 j-n	1.181 r	106.078 o-r	3922.33k-u
	V2	13.338 o-t	0.070 l-p	2.582 cd	127.677 h-p	4065.67 i-t
	V3	17.753 g-n	0.090 h-l	2.511 d	146.042 f-j	4811.83 d-k
	V4	10.523 r-v	0.065 m-q	2.102 h-j	142.131 f-l	3325.66 q-w
	V5	8.921 uv	0.045 q	0.781 t	99.119 p-s	3639.17 l-v
	V6	9.950 s-v	0.050 pq	0.531 u	61.044 t	1869.50 y
	V7	14.812 l-q	0.055 o-q	0.810 t	112.036 m-q	2939.01 u-x
	V8	9.559 s-v	0.085 i-m	0.711 t	99.129 p-s	3660.67 l-v

V9	16.352 i-q	0.125 c-e	1.421 pq	143.139 f-l	3167.33 r-x
V10	12.192 q-v	0.085 i-m	1.401 pq	138.102 f-n	3497.67 p-w
V11	8.576 v	0.060 n-q	0.961 s	81.566 r-t	2711.83 v-y
V12	9.227 t-v	0.045 q	1.421 pq	119.091 j-p	2607.50 w-y

Means in each column, followed by at least one similar letter(s) are not significantly different at 5% probability level using Duncan's Multiple Range Test.

Table 6 - Correlation coefficient between grain yield and physiological characteristics of rice genotypes

	1	2	3	4	5
1- grain yield	1				
2- Average total leaf area	0.462**	1			
3- Average total leaf dry weight	0.476**	0.724**	1		
4-Panicle weight	0.429**	0.481**	0.405**	1	
5-Average total floret the panicle	0.464**	0.463**	0.524**	0.669**	1

* and **: Significant at 5% and 1% probability levels, respectively

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