Study the interaction of cultivation date and variety on the process of changes in leaf surface index, growth rate, net absorption rate, leaf surface ratio and relative growth rate of ten varieties of rice in winter and summer cultivation date in Khuzestan province

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Abstract: This research conducted for determination the role of physiologic indexes on the process of production different varieties of rice in summer and winter planting in Khuzestan as an split-plot experiment in the frame of completely randomized blocks design with two factors (planting date and varieties) and 3 replication in 2009 for one year in Shavoor Agriculture Research Station dependent on natural resources and Agriculture Research Center of Khuzestan (31º: 50´ N W, 48º:28´ E L). Native and tolerant varieties to condition of warm weather test area such as Hamr with the time period of growth more than the highest process of leaf area index, crop growth rate, leaf area ratio, relative growth rate and have the most appropriate changes process in each three dates of planting, there is a positive correlation between them (at 1%). The highest net absorption rate is related to the revised varieties such as Dollar and Zanjan pollen due to premature and small bushes and lower respiratory and the most favorable process of changes of net absorption rate have revised varieties. There is negative correlation (at 1% surface) between product growth rate and leaf surface ratio as well as there is negative correlation (at 5%) between crop growth rate (CGR) and relative growth rate (RGR), also negative correlation (at 1%) was established between the net absorption rate (NAR) and relative growth rate RGR. There is negative correlation between the NAR and leaf area ratio (at 1%).
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Key words: Interaction, date of cultivation, varieties, changing process, characteristics of leaf surface

1- Introduction:

Rice cultivation maybe the oldest cultivation in Asia. This product alone, accounted for itself nearly 18 percent of total calories produced by the plants. 85 percent of all its production is fed by humans as food while human consumption of wheat and corn, is 60 and 55 percent, respectively. Rice is the main dish for over 2.5 billion people in the world and energy, 21% and protein 15% of the world (6). After wheat, rice is the second strategic product which is located in people's food basket in the world and because of its role in food security is located in self-sufficiency policy in the country. The area under rice cultivation in the world in 2007, more than 156 million hectares with annual production of 2/650 million tons of rough rice that over 135 million hectares of these lands are located in Asia (7).

Iran produced 2612174 tones and 630,562 hectares area under cultivation, is the most important countries producer of this crop in the world (5). Khuzestan with production 219,809 tons of rice and 58,015 hectares the area under cultivation has fourth place in terms of area under cultivation and has fifth place in terms of production in the country (2). According to the importance of rice in people's feed, the need of increasing production of this crop is felt in the country and according to the limitation of agricultural lands in Khuzestan, winter cultivation of rice in lands which do not have the ability of production of other agricultural crops and efficient use of water resources and current energy in the province and harvest more than one rice crop per year and reduction the costs of production can be achieved (1).

In the summer, cultivation of the rice, due to the high temperature, the abundant of water is required for reduction of canopy microclimate temperature. In the winter cultivation, evaporation, water use and soil salinity is also reduced due to low temperature. The winter rice cultivation does not interfere with other crops. Wetlands do not have ability of cultivation any crops, except the rice cultivation in Khuzestan province, which removes this concern; therefore, winter cultivation of rice in the current period of province does not cover the status of valuable plants such as wheat. Access to best management practices of the rice winter cultivation through researches of crop breeding is possible, it is important to select the right variety and planting date.

Therefore, this study was conducted to determine the date of planting and suitable varieties for winter cultivation and during this process, 10 genotypes were evaluated on three planting dates. The test was designed with the aim of achieving to the relationship and the role of physiological parameters and the

process of growth and their formation and effect on the performance of rice grain varieties in winter and summer planting date.

According to done research, the number of Khushcheh decreased in each cluster under conditions of high temperature (8). In the intensive cultivation of rice and high levels of nitrogen fertilizer, leaf surface index can be almost 10 or more than (9). Photosynthesis of plant community primarily is determined by absorbing solar radiation, the rate of photosynthesis per unit of leaf area, leaf surface index and angle of leaf (11). The temperature of environment can slow the increasing process of CGR. When photosynthesis increases in desired condition, CGR also increases (3).

In test, Sato (1960) provided clear evidence of the much sterility due to the rise in temperature (10). Yoshida (1981) stated that sterility occurs in rice when the plant at the stage of flower to be exposed at 35 ° C for more than an hour (12).

2- Materials and Methods

The study were running at the Shavoor Agricultural Research Station, related to Agricultural Researches Center in Khuzestan province, located 70 km north of Ahvaz between Karkheh and Karun rivers in 2009. Latitude 31 degrees and 50 minutes north and longitude 48 degrees and 28 minutes east, and its height from sea level is 33 meters.

The study was conducted in the method of split-plots designing in a Randomized Complete Block design (RCBD), three replications, two factors such as planting dates and varieties. The main factor i.e planting date was studied on three levels: 15 March 2009 (D1), 14 April 2010 (2) and 26 may 2010 (D, (3 and subplots including: Hoveyze figures (V1), Hamr (V2), pollen of Ramhormuz (V3), US $ (V4), N22(V5), pollen Zanjan (6V), foreign Dolain sent from the Erie (V7 and V8) and internal Dolain (V 10 and V9).

In this experiment, 10 varieties and the following promising line are considered as subplot. Hoveyzeh rice type is Khuzestan local varieties and mainly is grown in the Azadegan and Hoveyzeh city. Hamr rice type has the following features:

Completely tolerant against heat and salinity, very early, short-to-medium and high height, high tillering, a little clusters, high & rough light-green leaves with narrow stem which is sensitive against lodging and is cultivated in the Shadegan area more than other parts of the province (3.4). Ramhormuz rice type has the following feature:

Tolerant against heat, mass bush with many leaves and tree branch, good green cover, foot long, mass & spray bushes and curved & claw crow cluster, quite right flags and paddy grains rice with red colored.

Rice pollen type, have relatively high performance but it has the moderate commercial value, cooking qualities, and taste. Rice pollen types have a high resistance to pests and diseases and tolerant to water scarcity and drought stress tolerance (1). The Dollar type, the origin of this type is from India and adapted to the cold. Long grain form, thin and it's color is reddish white and raw grain length is 7 to 7.5 mm (mean 25.7 mm).

During the studies that have done, this type especially in the summer, is well-suited to the conditions of province as well as it has well Raton cropping and somewhat sensitive to lodging the and in comparison with other types in province, it is premature.

The N22 is international varieties which is heat tolerant. Short height and a high tillering varieties. It has small round seed and is somewhat similar to the seeds of Hoveyzeh. This type is consistent with condition of the province, especially in the summer cultivation and partly has the property Raton cropping and is premature varieties.

Zanjan pollen variety, is local varietyies of Zanjan area and very resistant to cold weather conditions, in terms of appearance, it completely looks like Ramhormuz pollen with the difference that the weight of one thousand grains higher and the number of grain in less cluster than Ramhormuz pollen. This type is premature and is relatively short leg, it relatively has good compatibility especially in cold weather conditions in March and in the case of proper management, it is harvested before the start of hot air.

7V (C 547-1-2-3) and 8V (IR 1561-228-3-3) foreign varieties are being introduced. Their origin in North America and they are varieties which is tolerant to heat. They are small leg and full tillers and with long and narrow grains. Lines 7 and 13 (V9 and V10), choice of generations is a breakdown of crossing varieties Hoveyzeh, Champa and red Anbory in Khuzestan province with three varieties of rice in Mazandaran including the Nemat and Fajr varieties which are the hybrid seeds and tolerant to heat.

The number of experimental plots in this study equal to 90 plots (30 plots in repetition), and each experimental plot is considered with an area of 7.5 square meters (m 3 × m 2.5). The deletion of 50 centimeters from both sides of plot has done as the border.

In the first iteration of the primary and secondary levels were classically located but on the second iteration, the levels of numbers and main factors were considered randomly. sampling was done every 20 days after performing the map of test plan.

Land preparation operations after reaching the soil moisture to limitation agriculture field capacity field (FC) through the exercise of plowing by ploughshare, twice disk perpendicular to each other and leveling coatings (leveling) was done, then plan after terracing and the establishment irrigation canals and drainage was done by boundaries and digger.

After the operation of land preparation and creation of the condition of mud fail plots to height of 3-4 cm were irrigated, then seeds were germinated in the three days before each planting date were soaked in water, base on 80 kilograms of seed per hectare is calculated and the plots were sowing.

To increase the temperature of the water in the plot and stimulate growth, water height is increased level to a height of 8-10 cm, this situation has continued until stem emerge completely from seed (5-4 days). Then the water level is fallen to the previous state (3-4) cm by starting with rice seedling stage, without draining the water from the plot, the amount of water in plot (height of irrigation water) was kept at the same level.

Based on the results of soil analysis and fertilizer recommendation, potas from source of potassium sulfate at the rate of 100 kg per hectare, phosphorus from source of ammonium phosphate at the rate of 50 kg per hectare, zinc from the source of phosphate at a rate of 40 kg per hectare for application soil and planting time were consumed.

The nitrogen element from urea compost source at the rate of 250 kg urea per hectare at four parts of 25%, including the finishing stage of seedling, the beginning of stem elongation (end of tillering), stage of pregnancy and time of 50% emergence of cluster without constant layers of water at the foot of plants were used at 9 varieties, but the Zanjan pollen rice 150 kg per hectare is used with the same parts. weed control like integrated includes hand weeding and using herbicide D 2-4 at the rate of 1/5 liter per hectare was done. In this physiological study, the index of leaf area, leaf area ratio, crop growth rate (CGR), relative growth rate (RGR), net assimilation rate is measured in periods of 20 days and was calculated on the basis of calculation formulas, measurement and calculation parameters were listed as follows:

All the leaves sampled from each plot (each plot a box 25 * 25) was separated from the junction to the sheath and 25 leaves from each sample was calculated by hand and by measuring, the length and their widest part by ruler and the following relationships. Formula (1): 75% (The most broad leaf width * the longest leaf length) = leaf area and then according to harvested leaf area and the achieved level by the empirical formula, leaf area index was calculated for each treatment.

$$LAI = \frac{LA}{S}$$

Formula (2): Meanwhile, the rate of remaining leaf area was calculated (in addition to 25 leaves were measured with a ruler and manually) through the fitting between their dry weight with dry weight of 25 leaves. To evaluate the growth process and accumulation of total dry matter of each plot of a sample (with an area of 25 by 25 cm), within 20 days, the ground stop and all parts of it, including the leaves, stems and clusters are separated at 72 ° C and for 48 hours inside the oven-dried and then weighed by the scale with accuracy of 0/02. In this experiment depending on variety or line and their date of planting between 8-7 times took samples from all experimental plots.

The total weight of dry matter as dry matter all plants are considered. Measurement and calculation dry matters of leaves: separated leaves from the stems of each sample was weighed in a paper bag before, for 48 hours and they insert in an oven with temperature 72 ° C. Then samples were removed and weighed. Leaf area ratio (LAR): (cm m g) formula (3) $LAR = \frac{LAI}{TDM}$, formula (4) $LAR = \frac{RGR}{NAR}$ growth rate (CGR): grams per square meter per day formula (5):

Where W2, W1 dry weight at the start and at the end of the time period, t2, t1 and SA soil surface is occupied by the plant. Relative growth rate (RGR): gram to gram dry weight is stated at the day.

Formula (6):

$$RGR = \frac{CGR}{TDW}$$

Formula (7):

Where W is the weight of dry and dw / dt dry matter change per unit of time. Net assimilation rate (NAR): grams per square meter of leaf area per day on the formula (8):

$$NAR = \frac{1}{A}\frac{dw}{dt}$$

where A leaf surface and dw / dt change weight of plant dry matter per unit of time. Formula (9):

$$NAR = \frac{CGR}{LAI}$$

Statistical calculations and determination correlation coefficients with using SPSS software and curve were drawn by EXCEL software.

3- Results and Discussion:

1-Interaction date of cultivation and varieties on the process of significant changes leaf surface.

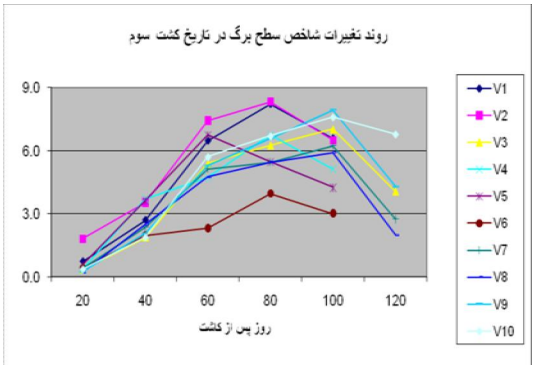


Figure 1-1:

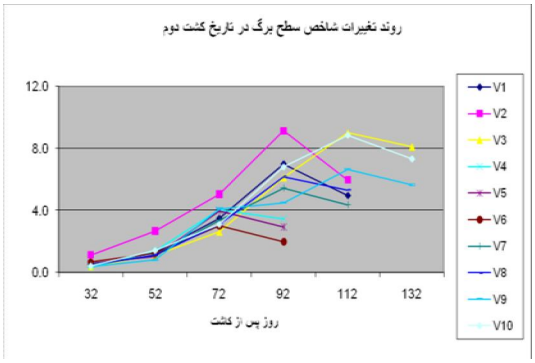


Figure 1-2:

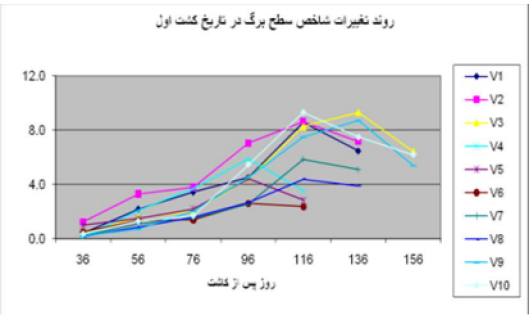


Figure 1-3

LAI curve initially increases and then decreases. varieties reactions varied depending on date of cultivation. On the first cultivation of 36 to 100 days after planting Hamr variety was on the top of the curve. 116 days after planting the winter variety, V10 has highest LAI after it deteriorate due to aging. 136 days after cultivation in the same date of cultivation of variety of pollen, Ramhrmzdaray was the highest rise.

On the second date of cultivation from 32 to 92 days, after planting, the highest rise has indigenous and tolerance variety, and after that it has the downturn. 112 days after cultivation, variety rice pollens Ramhrmoz V10 were on the top curves. On the third cultivation date from 20 to 80 days after planting, Hamr variety was on the top and then will decline. 100 days after planting winter variety, V9 has the highest rise (100 to 120 days after planting) V10 with a gentle slope and V9 with a quick slope was descent.

On the third date of planting, beginning of the curve, the development process of LAI rises faster, but its value in the first planting date, the beginning of the curve of LAI development is slow due to cool, but with increasing temperature, the rate of increase LAI goes up that at the time of emergence of cluster reach to it's maximum that the most number of LAI is V2 (Hamr) and the lowest number of V5 and V6 are (early varieties). In the second date of planting, the beginning of the curve due to increase in temperature, LAI is increased quickly.

In the first & second date of planting, the process of change is slow, the performance is so little or do not have at all but in the third date of planting due to having performance and active tank of premature leaves so they decay very soon and the rate production of leave due to increase of temperature is higher and the process of change is very severe. Thus native varieties tolerant to warm conditions in Khuzestan in each planting date were significant trends. (Figure 1-1), (Figure 1-2), (Figure 1-3).

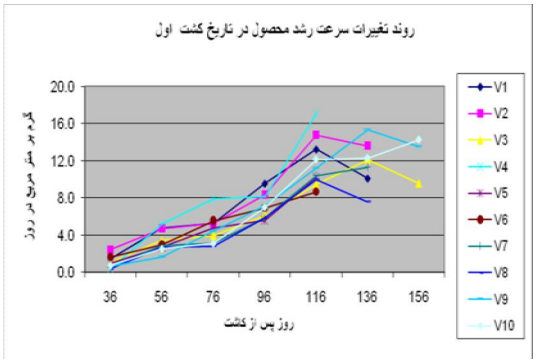


Figure 2-1:

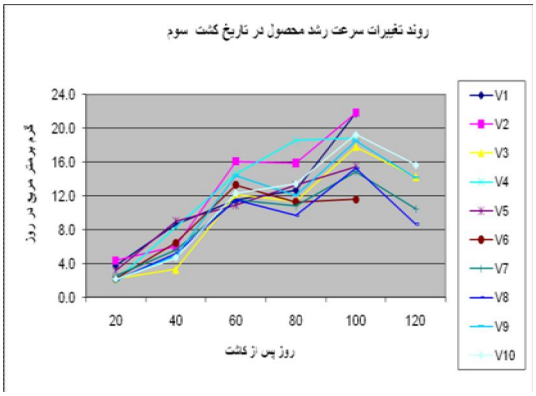


Figure 2-2:

Figure 2-3:

2. The interaction of date of planting and variety on changes process for growth rate of the product:

Growth rate is the weight change over time or in other words, aggregation of dry matter per earth surface is called CGR. The rate of plant growth is slow in initial stage and increase gradually until it reaches to its maximum at the time of blossoming then reduce again. CGR shows great coordination with LAI i.e the somewhat by an increase in LAI, we have increase of CGR.

At any date of planting, growth rate and dry matter production mostly related to the type that is needed more leaf area index. Varieties reaction is different depends on the date of planting. In the first date of planting, 56 to 116 days after planting the Dolar & Hamr varieties are located at the top of the curve and the Zanjan pollen rice was at the bottom of curve. On the second date of planting native variety and tolerant Hamr from 32 to 112 days after planting were at the top of the curves and Ramhormuz pollen variety and V9 winter was located at the bottom of curve. On the third date of planting, native Hamr variety in 60 days and 100 days after planting was located at the top of curve that were located at the same surface with Hoveyzeh (100 days after planting) and Zanjan pollen rice was located at the bottom of curve. Therefore, native and tolerant varieties to warm condition of Khuzestan variety like Hamr, have the high growth rate at three date of planting. (Figure2-1), (Figure 2-2), (figure 2-3).

3. The interaction between planting date and variety on the process of net absorption rate changes:

In net absorption rate, contrast to RGR weight changes is assessed in comparison with the previous photosynthesis level (the old leaves surface). NAR curve initially increases and then decreases, the cause of increase NAR in the early stages is that the leaves were the young in initial stage, have the further productivity power, as well as shading less, but the advance of plant growth due to shading between the leaves and reducing the efficiency of photosynthetic older leaves, the rate of net assimilation is decreased. The cause of increase of NAR in the early stages of growth may be due to changing the arrangement of leaves or due to changing the light intensity.

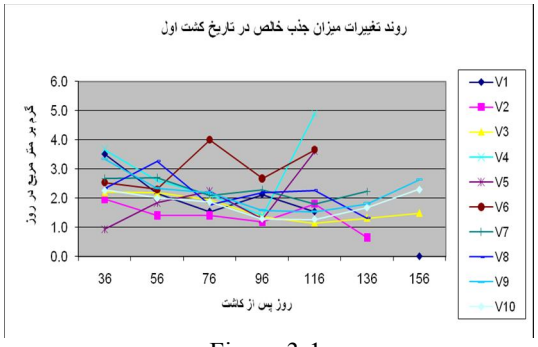
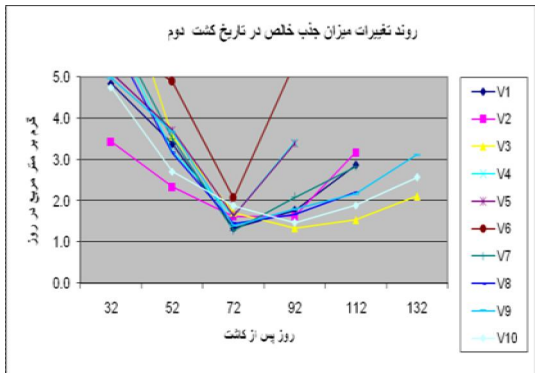


Figure 3-1:



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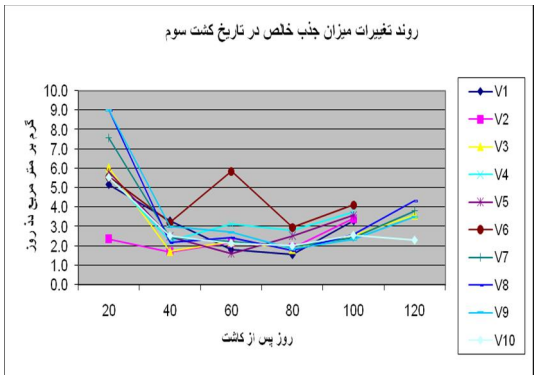


Figure 3-3:

Net absorption rate has direct relations with radiation and have inverse relationship with LAI reaction of varieties were different, depending on planting date. The first date of planting Zanjan pollen from 56 to 76 days after the planting was an upward movement and from 76 days to 96 after planting was downward movement.

At 116 days after planting, the Dollar type was on the top of curve and Ramhormuz pollen type was at a low level of curve. On second date of planting, Zanjan Pollen variety from 52 days to 92 days after

planting was at the top of the curve and Ramhormuz pollen type was located at the bottom of curve. On the third date of planting, 40 to 100 days after planting Zanjan pollen rice was at the top of the curve and V10 pollen was at the bottom of curves and net absorption rate was higher than the first and second cultivation.

Initially, that plant organs are small, breathing is lower, pure absorption rate is higher but they become mature and increasing maintaining breathe of the net absorption rate has been dropping. Revised varieties like Dollar & Zanjan pollen rice in each three planting date (due to smaller leaves and lower respiratory) had higher net absorption process. (Figure3-1), (Figure 3-2), (Figure 3-3).

4. The interaction between date of cultivation and variety on the changes process than leaf area:

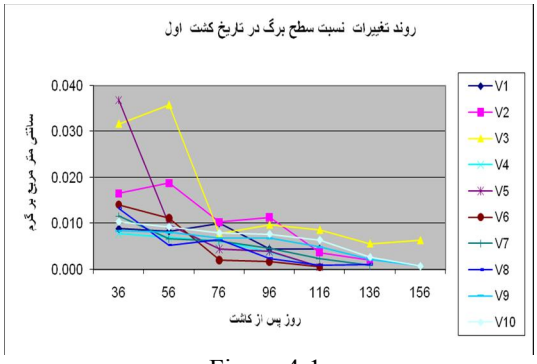
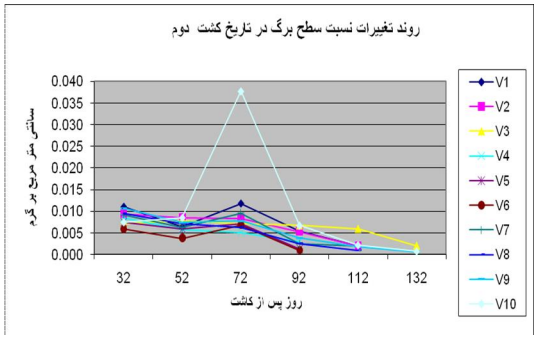


Figure 4-1:



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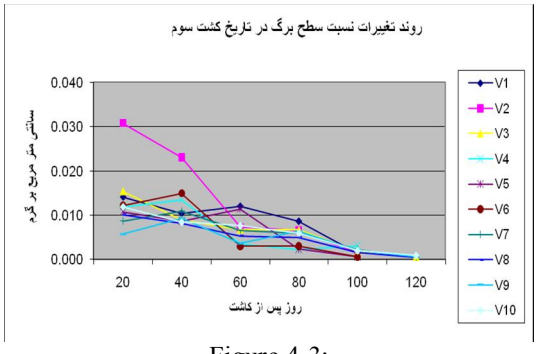

Figure 4-3:

Almost, in all crops until certain time from it's growth, show special attention to leaf spread and main part of photosynthesis materials, allocate to production and development of leaves so we observe or see increase the weight of other organs, particularly the canes, then the ratio will be reduced.

Varieties reactions depending on the date of cultivation was different. In the first date of planting, due to lenght of growth duration more than 36 to 56 days after planting pollens Ramhormuz, N22 were at the top of curves and then Hamr with the moderate changes process 76 to 96 were on the top and then 96 to 156 days after planting, Ramhormuz pollen, varietiey were at the top of the curve, then Zanjan pollen were at the bottom of curves. On the second date of planting, the ratio level of leave was lower varieties in the date of the first cultivation, and the difference was minimal. The winter variety V10 (52 days to 92 days after planting) was on the top of curve and after that native variety Hoveyzeh and Hamr were located. From 92 days to 132 days after planting, the Ramhormuz pollen was at the top of the curve. On the third date of planting, 20 to 60 days after planting Hamr was at the top and after 60 to 95 days Hoveyzeh was at the top of curve and the pollen Zanjan (60 to 100 days after planting) was at the bottom of the curve. Therefore, native variety and tolerant like Hamr at three date of planting, have high leaf area ratio. (Figure 4-1). (Figure 4-2). (Figure 4-3).

4- Interaction effects of date of planting and variety on the changing process of relative growth rate

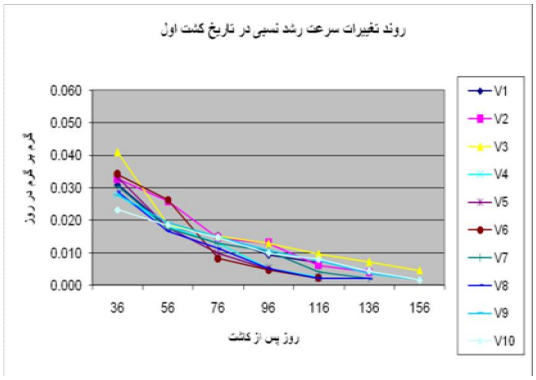

Figure 5-1

RGR stated rate growth without dependence on initial weight, RGR curve at first slightly increased and then decreased, the cause of gradual decrease in RGR is that in the early stages of growth almost all cells and tissues, were young and they were involved in the generation and sharing (In other words, they involved in the growth of the company), but overtime as the number of mature and dead cells, such as xylem and fiber increases, in fact, some of the cells or tissues

have no role in the growth and that's why RGR does not occur with past performance.

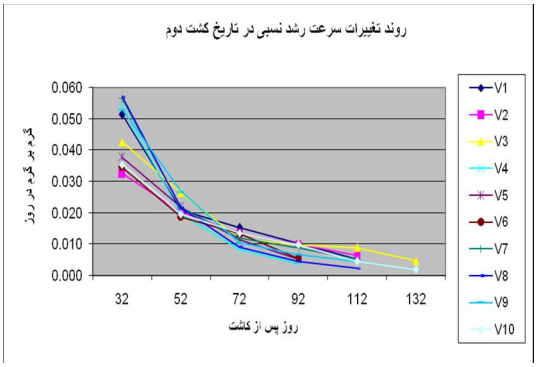

Figure 5-2:

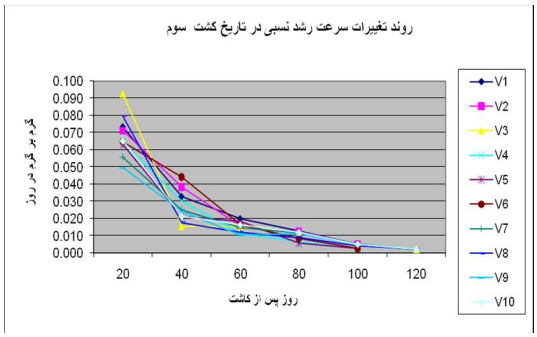

Figure 5-3:

Variety reaction varied depending on date of planting. In the first date of planting (36 days after planting) Ramhormoz pollen (V3) was at the top of curve. After 56 days, the Hamr and pollen Zanjan varieties were at the top, and then at the end of the growth (76 to 156 days after planting pollen Ramhormuz was at the top of curve and the difference was minimal.

In the second date of planting, at the beginning of growth (32 to 52 days after planting) varieties such as Dollars, V8, V9 and Hoveyzeh were at the top of curves, and then the decline. 72 days after planting, Hoveyzeh were at the top curves, and from 92 to 132 days after planting, pollen Ramhormuz was the highest curve and the difference between the varieties was very low. On the third date of cultivation (20 days after planting) Ramhormoz pollen variety was at the top, and then falling back all varieties such as Zanjan & Hamr in 40 days after planting was at the top, and differences was minimal and other varieties had dropping with little differences. Therefore, native variety and tolerant like Hamr have high relative growth rate process at three date of panting. (Figure 5-1), (Figure 5-2), (Figure 5-3).

Table 1: Correlation coefficients physiology features of rice varieties

	[1]LAI	[2]CGR	[3]NAR	[4]LAR	[5]RGR
LAI	1				
CGR	**300/0	1			
NAR	**778/0-	051/0-	1		
LAR	**617/0	**275/0-	**555/0-	1	
RGR	**617/0	*218/0-	**537/0-	**795/0	1
	[1]LAI	[2]CGR	[3]NAR	[4]LAR	[5]RGR
LAI	1				
CGR	**300/0	1			
NAR	**778/0-	051/0-	1		
LAR	**617/0	**275/0-	**555/0-	1	
RGR	**617/0	*218/0-	**537/0-	**795/0	1
	[1]LAI	[2]CGR	[3]NAR	[4]LAR	[5]RGR
LAI	1				
CGR	**300/0	1			
NAR	**778/0-	051/0-	1		
LAR	**617/0	**275/0-	**555/0-	1	
RGR	**617/0	*218/0-	**537/0-	**795/0	1

5- Conclusion:

1. The most appropriate & the highest process of leaf area index at three date of planting related to local varieties such as Hamr and premature Zanjan & revised varieties have the lowest amount.

2. The most appropriate & the highest process of product growth rate, Hamr native variety has at three date of planting.

3. The highest process of net absorption rate at revised varieties the Dollar and Zanjan pollen was more than other varieties.

4. The most appropriate changing process of relative growth rate and leaf area ratio have native variety and tolerant such as Hamr.

5. The leaf area index, crop growth rate, leaf area ratio, positive correlation of relative growth rate (at 1%). Crop growth rate and negative correlation of leaf area ratio was (at 1%), respectively. CGR and negative correlation RGR (at 5%). Net absorption rate and relative growth rate also was negative correlation (at 1%), respectively. NAR and leaf area ratio was negative correlation (at 1%).

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Reference:

1. Ahmadi, 2008. Examine the effects of winter date of planting on yield and yield components of rice in conditions of Khuzestan province. MA thesis in the field of Agriculture, Islamic Azad University of Dezful. 170 pages.
2. Agricultural statistics letter, 2006-2008. Ministry of Agriculture.
3. Moradi, F.1996. examination of interaction Nitrogen compost and density of plant on the cultivation of red Anboori transplanting in Khuzestan condition, reporting of rice research. Agricultural Research Center of Khuzestan, Ahvaz.
4. Mombeini, M.2002. the effects of split nitrogen compost on the resources of dried matter grain supplies in two rice varieties, in terms of Climate southern Khuzestan. MA Thesis, Islamic Azad University of Dezful. Faculty of Agriculture. Group of agriculture and plant breeding. 144 pages.
5. FAO database. 2007. for rice area, Roma. for some Asian Countries.
6. FAOSTAT. 2007. FA O statistics Division 2007 Last accessed 02 August 2007PROD stat.
7. FAo. 2009. Rice price, commodity Markets, policy Analysis and projections service, Trade and Markets Divison.
8. Greenfield, S. M. Fisher, K. S., and dowling, NG.1998. Substainibili ty of rice the Global Food Systen. Ist. Ed. Los Banos Philippines.
9. IRRI (International Rice Research Institute)1973. Annual 1972. Los Binos philippines, 246 P.
10. Sato, K. 1960. Accelerating generations of rice varieties by short day. 38 p.
11. Venkateswarlu, P. 1977. Inf Luence of Low Light intensity on Growth and productivity of rice (oryza sativa L.). Plant soil 46:713-719.
12. Yoshida, S 1981. Funde nentals of rice crop Science. IRRI.

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