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The Effect of Different Planting Dates on the Anatomy of the Flag Leaf and Grain Yield of Rice Varieties in the Khuzestan Region, Iran

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Abstract

This study aims at investigating the effect of different planting dates (change of ambient temperature conditions) on the flag leaf anatomy and function in rice and a village located 70 km north of Ahvaz, Khuzestan, Iran. A split plot experiment was used based on randomized complete block design with three replications. The main factor was in the three levels of planting date (25 May, 9 June, and 25 June) and the second factor was in three levels including Red Anbori varieties (long and short) and Champa. Analysis of variance showed that in all characteristics there is a significant difference between the impact of different planting dates and numbers at 1% level and there is a significant difference between these two factor interactions in the surface characteristics of wood and xylem bundles drain at 5% and 1% levels respectively. The highest and lowest yields and levels of large vascular bundles, small, wood and phloem belonged respectively to the first and third planting dates. Grain yield had the most significant positive correlation with the level of the small vessel (0.905**), the timber vessel (0.810**) and phloem (0.428*) which indicates a direct high impact of these characteristics on increasing the performance and also reveals the need for further remedial investigation so as to improve the performance. Among figures, the highest one belonged to the performance of Champa with the average 3795.4 kg per hectare. Number of large (on the 1 length mm) and small (on the 5 length mm) vascular bundles and buliform cells (on the 5 length mm) were not affected by planting date and were identical in all figures.

Keywords: planting dates, rice, flag leaf, anatomy

1. Introduction

The select the appropriate planting date for the planting of rice varieties are genetic factors, the optimum use of capacity. Suitable for planting on the optimum efficiency of the factors affecting the performance (Ali & Rahman, 1992). Forming properties of building plants on ecological behavior, environmental requirements and compatibility with surrounding plants have a significant effect (Metcalf & Chalk, 1950). Used of features construction plant morphology is nearly a century ago (Metcalf & Chalk, 1950). About 40 years ago, great changes occurred in the study of structure forming plants and plant classification was used in this science. Some scientists have stated that the structural features of plants are important in the response of plants with different conditions. Today all aspects of building forming plants considered by plant morphology and the results obtained in this area is very important constituent of the traits associated with building plants to achieve optimum performance with respect to different environmental conditions that gives (Rudall, 1994; Metcalf & Chalk, 1950; Heywood, 1985; Cutter, 1971; Carlquist, 1961; Ali et al., 1989). Has the effect of environmental conditions on stomatal frequency. Leaves of plants in arid environments and can grow in high light has smaller holes and more than shade leaves of plants that are grown in humid environments. The number of stomata in the leaves of a plant will not only single but also is different in different parts of a leaf (Rudall, 1994; Metcalf & Chalk, 1950; Heywood, 1985).

Although limited information from the constituent building plants because there is very little research the general symptoms of increased heat resulting changes in the level of a plant include: reduced cell size, stomatal closure and reduce water losses, increased stomatal density and fuzz, a wooden vessel is larger than the roots and aerial parts (Anon et al., 2004). Several studies revealed that heat tolerant crop plants have higher stomatal density, stomatal aperture less leaves thicker, more compact arrangement of mesophilic cells, vascular bundles are more fully developed and stable structures are cellular organelles (Han et al., 1997). Results of an investigation related to late planting of rice agriculture in China showed that the effect of high temperature air, chemical and biological processes within the chloroplasts of leaf cells of rice were damaged and there were some differences between the rice varieties. Microscopic study of flag leaf structure of Line No. 996 (tolerant) and 4628 are sensitive to heat thermal stress (37.30°C) can be found online in China suffered a well developed vascular bundles in the middle vein, also has a large vascular bundles (with 2.0105 square micrometers) and mesophilic cells with a very strong bond they had together. The openness of the openings in the thermal stress tolerance in very low numbers and even some of them were completely closed, and while this was not developed in the vascular bundles were not only sensitive, but the openings were usually open space the cell was very high in mesophilic cells (Zheng et al., 2009). Crop response to low temperatures depends on weather conditions from which they originated, there. Tropical and subtropical plant origin such as rice, are very sensitive to low temperatures and its growth in the face with a temperature below 15 degrees Celsius are difficult (Allen & Ort, 2001). The response of plants sensitive to frost, is the rapid increase in photosynthetic inhibition (Ort, 2002). Guilani (2010) with the structure forming the examination revealed that flag leaf under the influence of heat stress tolerant rice varieties have smaller pore aperture and xylem wood. Bell and colleagues (Zheng et al., 1998) reported that the structure of rice flag leaf to flag leaf temperature, the amount of damage to the chloroplast structure is different.

Limochi (2012) with reviews on the flag leaf vascular bundles, while announced tolerant cultivars of rice has the potential to increase drug levels are smaller vascular bundles, found that the rice planting in the warmer months of the year to maintain the surface potential of the vascular bundles water, increasing the efficiency of photosynthesis and respiration rates, is less. He continued failure to affect the number of vascular bundles and cell buliform influence of environmental conditions (depending on genotype) was proven. Limochi (2012) also examined different planting dates on ten varieties of rice; reduce the period to reduce the transmission of data to non structural carbohydrates to the main reservoir of seed yield loss as the factors. Grain structure of the constituent elements of the flag leaf is important in influencing production could eventually play an important role in the provision of dry matter for grain. But this effect can be quite affected by environmental conditions. Details of the constructive elements and plant tissues, a better understanding of certain actions and adapt to different environmental conditions, provides. Without knowledge of the structure (anatomy), plant physiological processes within plants are not understood and can not be designed experiments in physiology and ecology. The study of the effect of sowing time on building the flag leaf in rice and in the province with the aim of building the flag leaf in rice production in different conditions of heat stress have been performed.

2. Materials and Methods

This study reviews the anatomy of the flag leaf and yield of rice in the Khuzestan province with longitude 48˚28″ and latitude 31˚50″ with 33 m above sea level, clay soil loam pH near 7.2 and electrical conductivity of 3.1 m mous/cm. Tested in 2011 as a split plot randomized complete block design with three replications in plots of size 2.5×4 m was carried out. Main planting date at Level 5 in the 25 May (d_1), 9 june (d_2) and 25 June (d_3) as main plots and cultivars include: Red Anbori feet long (V_1), Champa (V_2), Red Anbori legged short (V_3), were considered as subplots. Average monthly temperature of the May 2010 (the first planting date) to October 2010 (the end), respectively, 37.1, 38.3, 39.2, 36.5, 32 and 24.4°C, respectively. Rate of consumption of 80 kg seed/hac and a sprinkling of seeds germinated in soil saturated with water and a combination of hand weeding and weed control using 2-4 -D, the value 1.5 lit/hac tooked control. The nutrient requirements based on soil test (Table 1) were determined and used, the source of phosphorus, ammonium phosphate and 50 kg/ha, 100 kg/ha of potash from potash and zinc sulphate 40 kg/ ha basis and when sprayed before planting the seeds were consumed. Source of urea nitrogen per 180 kg/ ha of which 50% in 3 to 4 leaf stage and 50% remaining at the end of tillering and the beginning of pregnancy were used. For measurement of anatomical features, were isolated at the time of ear emergence and flag leaf of the plant after removal of the terminal and basal segments, cut into 2-3 cm length were taken from the middle part of the flag leaf. For the maintenance of laboratory samples and send them to the F.A.A's solution was used. In the laboratory, and a narrow cross section 10 × 10 mm using a manual method Polystyrene were prepared and stained, the samples after washing with distilled water for 15 minutes in bleach water and then 20 minutes in Carmen aluminize and finally for 10 to 15 seconds at each of the stages were methyl green staining were washed thoroughly with distilled water. Then samples for preparation of stained slides and pictures were placed on glass slides and attributes include: the level of large and small vascular bundles, the xylem and phloem, wood, large and small vascular bundles and cell number per unit area using a light microscope buliform with 10-40 zoom (micrometers) were measured.

Yield with 85% of the grains harvest in the cluster in an area of 1.5 m from the middle of each plot by removing margins, with a humidity of 14% was measured. The data obtained and compared with Duncan test at 5 and 1 percent level using the statistical software SAS (version 6.12.0.1) and compute data correlation using the software SPSS (version 11) was performed. Diagrams drawn by the software Excel (version, 2007) was conducted.

Table 1. Soil characteristics of the research farm

Soil texture	Absorbent micro elements (ppm)				K	P	N	EC	pH	Soil depth (cm)
	Fe	Mn	Zn	Cu	(ppm)	(ppm)	(ppm)			
Clay- loam	15.7	3.2	2.8	2.8	360	10	0.08	3.1	7.2	0-30

3. Results and Discussion

3.1 The Large Vascular Bundles

Flag leaf photosynthesis in rice is considered one of the major organs and because more leaf nodes outnumber print leaves exposed at the highest exposure to environmental stresses including temperature changes is the growing season. Anatomical changes in the flag leaf of one of the important approaches, especially in the face of climate change. Analysis of variance showed that the effect of planting date and cultivar at 1% level and the interaction of planting date and cultivar were no significant differences (Table 2). Simple effects showed that the highest average level of the third planting date with an average of 10517.7 square micrometers and the lowest level of the first planting date with an average of 9068.6 square micrometers and in the figures, the number of feet long Red Anbori allocated to the highest level data (Table 3). Considering that the vascular bundles, material handling system (Apo plast and Symylat) the plants are so changed in their structure can also cause impaired absorption of water and plant nutrients from soil and transfer them into plants and the transport of sugars and photosynthetic products from the production (leaves) to save or consume is impaired. Seems to lower levels of vascular bundles in the first planting date, regardless of the effect of high temperature and a mechanism to maintain water pressure is turgor cells. In the figures, regardless of the temperature effect, the result is more relevant to the dispute genotype. So that the number of smaller cells and Champa with thicker walls to maintain the water potential, low respiration rates and increased efficiency photosynthesis and water use, including breeding purposes (Figure 1). The direction of water in the plant and its exit from the hole, the vascular bundles with smaller level because most of them with the inner surface of the leaf epidermal cells (the site of water evaporation) to the transpiration takes place more in the first planting date can be seen. The ecological behaviors and on anatomic characteristics, environmental requirements and compatibility with surrounding plants have significant impact and vascular bundles of seeds is limited reduces fertility because of the anatomical features of plants that dates back nearly a century ago was used to classify plants. The above remarks about the role of vascular bundles in the allocation of materials according to different planting dates are consistent with the above sources (Guilani, 2010; Rudall, 1994; Metcalf & Chalk, 1950; Heywood, 1985) and the reduction in the degree of vascular bundles heat to raise water efficiency above are consistent with studies (Limochi, 2012).

Table 2. Analysis of variance for flag leaf anatomical features and grain yield of the experimental treatments

Factor		Area of large vessel (Square micrometers)	Area of small vessel (Square micrometers)	Area of timber vessel (Square micrometers)	Phloem area (Square micrometers)	Grain yield (Kg/ha)
Sowing date	d1	9068.6c	1178.455c	730.89b	896.22c	2645.44c
	d2	9821.7b	1398.011b	866.67a	978.67b	3618.11b
	d3	10517.7a	1485.56a	897a	1156.21a	4269.33a
Cultivar	V1	10163.6a	1308.67c	847.89b	964.89b	3492.6ab
	V2	9322.7b	1401.56a	904.56a	925.67b	3795.4a
	V3	9921.7ab	1351.33b	742.11c	1140.56a	3244.9b

ns, * and ** are nonsignificant and significant at the 5% and 1% levels of probability, respectively.

Table 3. Comparison of anatomical characteristics of flag leaf in rice

S.O.V	df	Area of large vessel	Area of small vessel	Area of timber vessel	Phloem area	Grain yield
Repeat	2	478909.370$^{n.s}$	1667.815$^{n.s}$	1388.259$^{n.s}$	1156.037$^{n.s}$	7328.926$^{n.s}$
Sowing date	2	4727273.037**	225984.592**	70422.926**	158884.592**	6010778.926**
Error (a)	4	99871.370	1276.315	3835.592	1040.426	12808.314
Cultivar	2	1686608.037**	19456.592**	61182.370**	117861.592**	684287.814**
Cultivar × Sowing date	4	313641.870$^{n.s}$	2829.592$^{n.s}$	4209.870*	59580.981**	85027.204$^{n.s}$
Error (b)	12	231314.703	987.481	1213.648	1014.185	56022.963
CV(%)		4.91	2.32	4.19	3.15	6.74

There are other similar letters in each column, with Duncan's test is significant at 1% level.

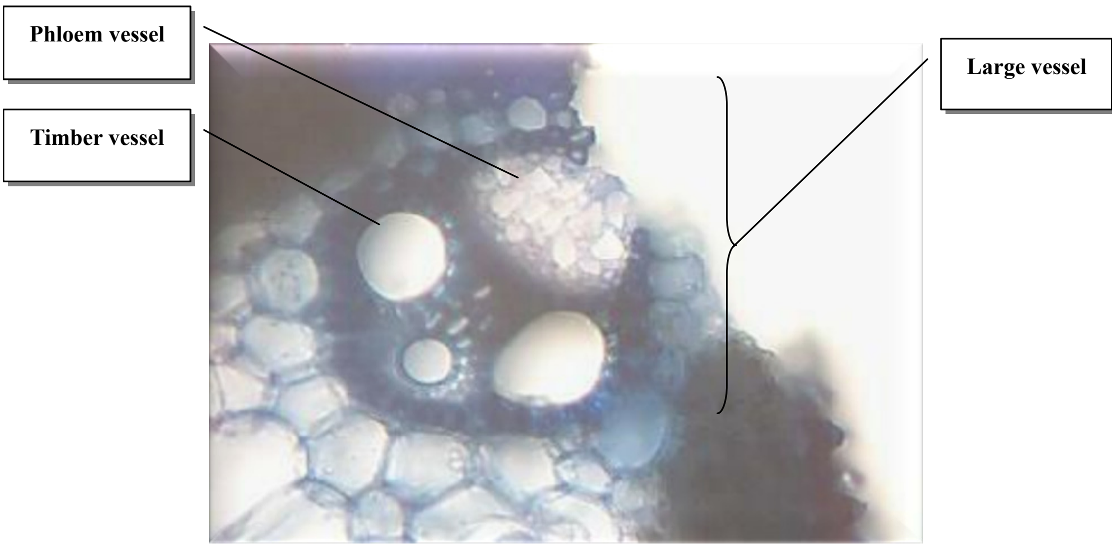

Figure 1. Vascular bundles of flag leaf

3.2 The Small Vascular Bundles

Analysis of variance showed that the effect of planting date and cultivar grown at 1% level was a significant difference in the interaction of two factors, but the difference was statistically (Table 2). The highest level of the third planting date 1485.56 micrometers square and the lowest level of the first planting date, with 1178.455 square micrometers and in the figures of the highest level of Champa that these results indicate that the bundles large and small vascular figures and a comparison of different planting dates used (Table 3). It seems that to achieve an optimal level of performance more vascular bundles (large, small) is required and also check the level of vascular bundles and their impact on performance components to provide material solutions such as sucrose and the synthesis of osmotic compounds and the role of hormones and their interactions in the vascular bundles sought (Figure 4). The results about the effects of different planting dates on the small vascular bundles is consistent with other studies (Limochi, 2012; Guilani, 2010; Metcalf & Chalk, 1950).

3.3 Level of Timber Vessel

The non living systems, transpiration a pure physical phenomenon is the production of propulsion of water and food. Given the importance of this pathway, changes in xylem different cultures on the environmental conditions and different temperatures can affect the absorption process and transport water and nutrients to be part of photosynthesis. These traits statistically influenced by planting date, cultivar and planting date and cultivar effects on the probability of error 1 and 5% showed a statistical difference (Table 2). The interaction between cultivars and planting date on wooden vessel to the highest and lowest levels respectively Champa varieties planted on the third with an average 947 square micrometers, and the short leg Anbori first planting on average 686.340 square micrometers (Figure 2). Considering that the movement of water in the timber vessel cohison force (attractive intermolecular hydrogen bonds that occur in water) under the influence of water absorption by a solid phase (xylem walls) or is edhison force the water up capillaries xylem vessel wall depends on the liquid contact angle, liquid surface tension and gravity ray and wood is applied on it. Capillaries because the upside of the vessel with its radius is inversely proportional to the force of any size is less xylem capillaries is holding more water and more pressure is needed for removing the water in the vessel on a short legged variety Red Anbori smaller timber vessel Water has to be maintained with more force (Figure 2). Results obtained with the report (Guilani, 2010) and (Limochi, 2012) is consistent.

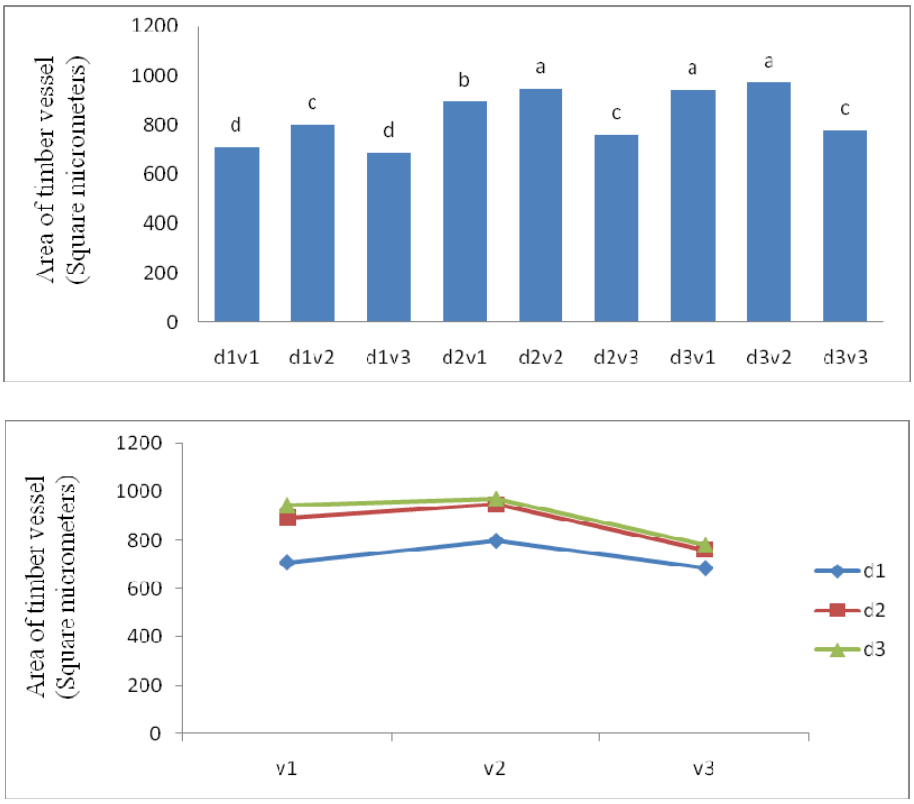

Figure 2. Compared xylem flag leaf area in the experimental treatments. There are other similar letters in each column, with the Duncan test at 5% level is a significant difference

3.4 Phloem Area

Phloem is the main route through which sugars and photosynthetic products through the production of materials (leaves) used to store or move. This path is called the symplast a more or less continuous system of plant cells by the protoplast. Plasmo Dasmata have been linked and also includes cells of phloem tissue is connected together. Cellular components of this system, living and are the driving force for material transport in the phloem and the law Mankh concentration in the loading and unloading are two places in this area (Yang et al., 2000) numerous studies done that fully complies with the above statements. Test results (Table 2) showed that planting date, cultivar and planting date and cultivar interactions significant difference in the level of one percent on the phloem. The highest level of phloem related plant on the third and lowest level of the first planting date, respectively, with an average of 1156.21 and 896.22 square micrometers. Unlike the other varieties of timber vessel Red Anbori short leg with an average of 1140.56 micrometers square and Champa varieties with an average of 925.67 square micrometers, respectively the highest and lowest level of the phloem bundles that can be allocated to the Wood consists of xylem and phloem interactions in the large vessel is limited space (Table 3). So that first implanted on the surface of a mechanism to maintain phloem photosynthetic products and their cost reduction through cell respiration is maintained. On the other hand phloem size depends on the size and source of objectivity and the relationship between them (Figure 3). Photosynthetic source and sink, so it appears smaller and smaller sizes on first planting and reduce the performance level of phloem in the history of the reasons that this particular reviews (Limochi, 2012) is quite consistent.

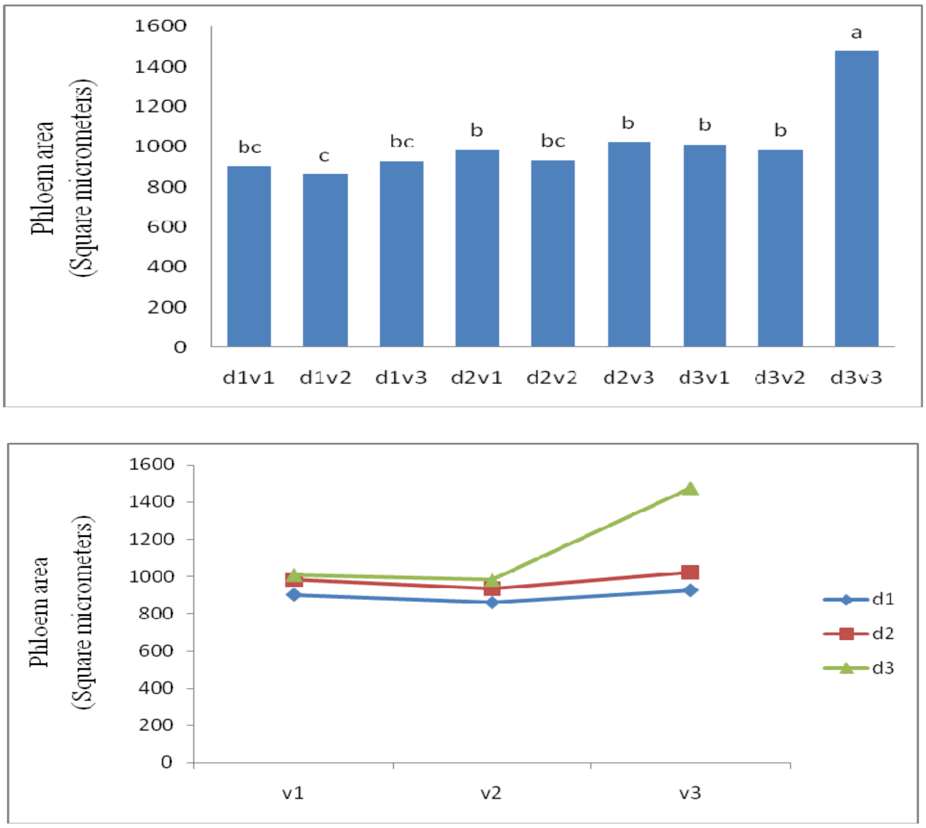

Figure 3. Comparison of flag leaf area of phloem in the experimental treatments. There are other similar letters in each column, with Duncan's test is significant at 1% level

3.5 Grain Yield

Grain yield significantly affected by planting date and cultivar were significant differences in the level of error of one percent (Table 2) but the interaction of two factors, planting date and cultivar difference was not statistically significant and the lack heat of the figures and also increase the growth period of the first planting date to the third and increase the amount of carbohydrates and minerals is transferred to the grain. Between the highest figures in the performance of Champa with the 3795.4 kg/ha, respectively, which can be influenced by genotype characteristics, environmental factors and the outcome and their positive integration in the last figure is the ultimate in superior production capacity of the reservoir and the accumulation of active higher dry (grain storage × seed number) in this figure compared to other cultivars (Table 3). The results are reported (Farrell et al., 2004) based on temperature and (Limochi, 2012) based on increased performance is consistent with increasing period. According to the Table 4 positive and significant correlation coefficients yield the highest correlation with the level of the small vessel (0.905**), the timber vessel (0.810**) and phloem (0.428*) environment and different levels of water and food availability, changes in their levels can have a major influence on performance.

Table 4. Correlation coefficients between grain yield and flag leaf anatomy traits

	Surface of large vessel	The small vessel	Level of timber vessel	Phloem area	Grain yield
Surface of large vessel	1	0.088	- 0.126	0.245	0.164
The small vessel		1	0.722**	0.530**	0.905**
Level of timber vessel			1	- 0.083	0.810**
Phloem area				1	0.428*
Grain yield					1

* And ** order is significant at the 5 and 1%.

3.6 Number of Large and Small Vascular Bundles and Cell Buliform

Material transfer in photosynthetic process, limits the number of vascular bundles are reduced seed fertility. Number of large vascular bundles between different planting dates and cultivars were similar and there was no difference between them and the average for all planting dates and cultivars were 1 mm over a batch of major vascular (Figures 4 and 5). Given that small vessel mainly vein subsidiary and branch of middle vein, are so focused on the surface, their number is also important. It seems that to achieve higher performance, a good number of vascular bundles (large, small) are required. Number of small vascular bundles on each planted 5 mm in length, which itself is indicative of different planting dates has no effect on the number of small vascular bundles. The numbers of small vascular bundles of 5 mm in length were between in all figures (Figures 4 and 5).

Because the number and type of cell elasticity or bubble buliform large role in the photosynthetic leaf area and thus is one of the important characters in the anatomy is considered. All results obtained in this study, the number of vascular bundles small number of cells was quite similar buliform that this represents the number of small vascular bundles and cell buliform with the number of small vascular bundles of all cultivars in all three on implanted with a 5 mm length were buliform cells (Figures 4 and 5). The results obtained using surveys (Limochi, 2012) based on failure to affect the number of vascular bundles and cell temperature conditions vary and depend buliform quite match their genotype. Conclusions: Due to the lower surface of vascular bundles in the first planting date (maximum thermal stress at ear emergence stage) it can be seen as a mechanism to maintain water pressure and turgor cells. Seems to focus on the reform goals of the anatomical traits to increase rice yield in terms of increased photosynthesis and increased respiration rates than photosynthetic efficiency and water consumption due to changing levels of vascular bundles in different thermal conditions had hoped. However, the number of vascular bundles and cells affected buliform completely different genotypes were independent of planting date.

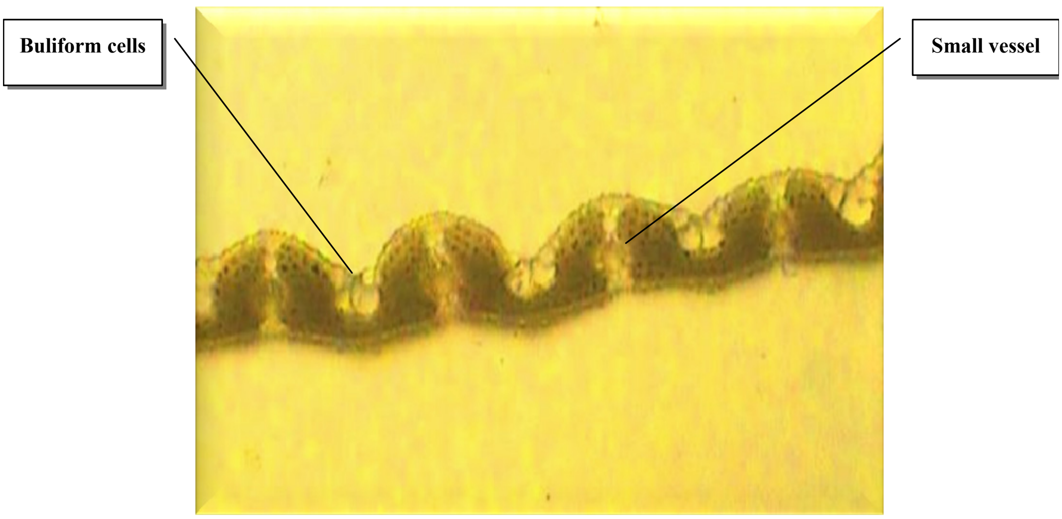

Figure 4. Transverse section of flag leaf

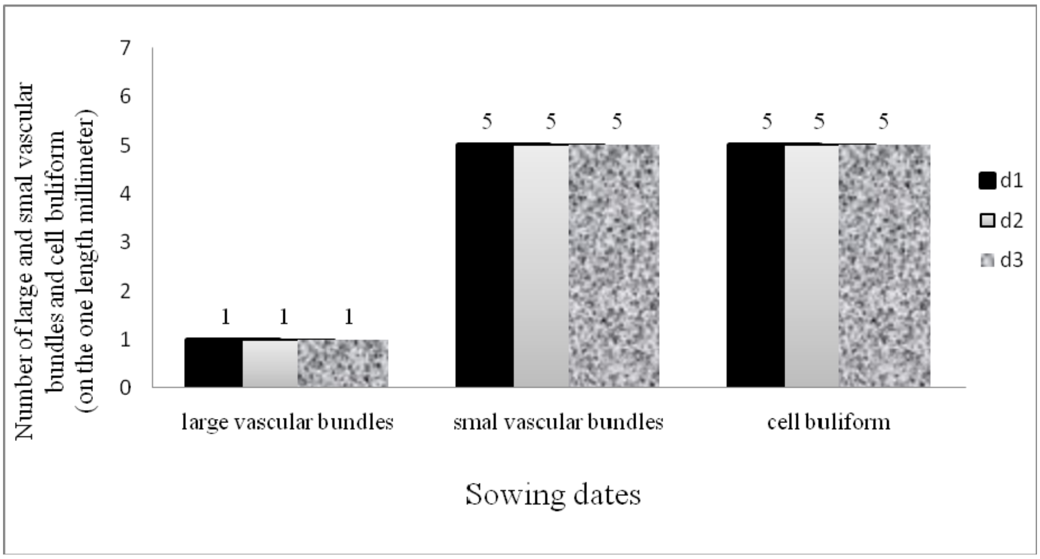

Figure 5. Changes in the number of vascular bundles, large and small cells within a millimeter Buliform affected by planting date

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