

Effect of Year, Planting Date and Plant Density on Yield, Nutrients and Photosynthetic Pigments in Leaves of Azivash (*Corchorus Olitorius* L.)

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Abstract

This experiment was laid out in order to investigate the effect of year, planting date and plant density on yield, nutrients and photosynthetic pigments of Azivash leaves at Shirvan Higher Education Center during 2018-2019. Experimental factors included five planting dates (May 1, May 18, June 1, July 1 and July 18), and two plant density levels (30 and 45 plants.m⁻²). In this experiment, leaf dry weight, nitrogen, phosphorus, iron and copper and photosynthetic pigments were measured in Azivash plant. The results showed that the effect of year, planting date, plant density and their interaction had a significant effect on most of the studied traits. Based on the present results, the amount and quality of production in 2018 were better in comparison with 2019. Between two 30 and 45 plants.m⁻² densities, dry leaf yield and more photosynthetic pigments were higher in 45 plants.m⁻² compared to 30 plants.m⁻². Also, between all planting dates, the highest dry leaf yield was founded in 1 June planting date in rate of 1425 and 1378 kg.ha⁻¹ for 30 and 45 plants.m⁻² respectively. In general, based on the results of this experiment, it should be stated that planting date and plant density had a significant effect on dry leaf yield and other traits of Azivash leaves. So, choosing the appropriate planting date and plant density will increase Azivash leaf yield and leaf quality.

Keywords: Planting date, plant density, leaf yield and Azivash

INTRODUCTION:

Azivash (*Corchorus olitorius* L.) is a plant belonging to the *Tiliaceae* family. Azivash has been cultivated for centuries on both continents of Asia and Africa and is found in the wild type on both continents, but its wild species are founded with greater genetic diversity on the African continent (Oomen and Grubben, 1978). This plant has about 40 species, which most of them are scattered in the tropic regions. Azivash is called Udo in Nigeria, Mulukhi in Arabic, and Tossa jute, Wild okra, and Jute mallow in English (Samra et al., 2007; and Porta, 2011).

This plant is the most important leafy vegetable in Egypt, which is very popular as a summer vegetable due to its special taste that is consumed in fresh or frozen forms (Ooman, 1978).

Grubben and Denton (2004) reported that Azivash plant are now widespread throughout the tropic regions and are growing in almost all African countries. This plant is cultivated as a vegetable in the Caribbean, Brazil, India, Bangladesh, China, Japan, Egypt and the Middle East. Also, Azivash plant cultivated in West Africa, especially in Nigeria, and is widely consumed by all people. Azivash often used in dried form in West Africa. It is also, cultivated in Malaysia, the Philippines and parts of the United States as one of the most important vegetables (Oyedele et al., 2006).

This plant introduced for the first time in Iran by Ghorbani et al. (2013) after two years field research in Gorgan University of Agricultural Sciences and Natural Resources in Golestan province by ensuring that it can be planted and harvested in gorgan environmental condition. Any crop or medicinal plant in any region should be cultivated when the plant is exposed to the least stress during the germination, emergence and subsequent stages of development (until harvest). This planting time is named as the optimal planting time. This does not mean that when plant cultivated in optimal date, it does not face to stress, but exposed to lower stress compared to other planting dates (Khajehpour, 2011). Plant cultivation at the appropriate date increases yield due to creating suitable environmental conditions in all stages of crop growth, (Mostafavirad et al., 2012; Latifi et al., 2010). At proper planting date, flowering is stimulated after sufficient vegetative growth (Latifi et al., 2010). Selection of appropriate planting date is necessary for higher crop productin, better plant establishment, germination, and fast and uniform germination along with the production of strong seedlings, (Ajam noroozi et al., 2009). Planting time for each region should be determined separately based on the climatic conditions (Mishra and Nayak, 2004).

Determination of best planting density for achieving to higher yield is one of the main important necessities in agronomic planning (Babaei Abarqhuei, 2002). The crop yield is the result of intra-species (between different plants) and intra-plant (competition between different organs of plant with each other) competition for environmental growth factors (light, soil nutrients, etc.) and obtaine maximum grain yield per unit area when these competitions are minimized and the plant can use maximum existing growth factors, (Khajehpour, 2011). In this regard, Wealy and Hayes (1970) reported that plant density affects on inter-plant competition, vegetative and reproduction growth. Suitable density and balanced distribution of plants per unit area leads to better use of moisture, nutrients and light that resulting to higher crop yield. Plant density per square meter is one of the main factors affecting grain yield and is the first determined factor during the crop growing season (Keshiri et al., 2006).

There are very little study and research on cultivation and harvesting of Azivash in Iran. Determination of cultivation and harvest possibility of Azivash in different planting date and plant density is the first steps of Azivash use. Therefore, this study was laid out in order to evaluation of planting date and plant density on quality of Azizush plant in Shirvan region, North Khorasan provinc, Iran.

METHOD:

This experiment was laid out in order to investigation of the effect of planting date and plant density on quality characteristics, photosynthetic pigments and leaf yield of Azivash (*Corchorus olitorius* L.) in Shirvan region. The filed site located 3km distance from Shirvan-Mashhad road. Experimental factors included five planting dates (May 1, May 18, June 1, July 1 and July 18), and two plant density levels (30 and 45 plants.m⁻²). Before seed cultivation, in order to achieving to suitable culture medium, the filed land was ready using sufficient plowing and disc operation.

Table 1- Meteorological data of Shirvan meteorological station during planting and harvesting of Azivash groeing season at 2018-19..

Parameter	Year	Farvardin		Khordad			Shahrivar	
		(21 March-20 April	Ordibehesht (21 April-20 May	(21 May-20 June)	Tir (21 June -20July)	Mordad (21 July-20August)	(21 August- 20 September)	6 Month average
T _{min}	2018	5.7	8.4	14.2	16.8	17.3	12.4	12.5
	2019	6.1	8	12.8	17.8	15.8	12.1	12.1
T _{max}	2018	20	23.9	31.3	36.9	35.5	31.4	29.8
	2019	17.4	23.5	29.4	36.5	34.3	29.9	28.5
T _{average}	2018	12.5	16.1	23.9	28	26.7	22.1	21.6
	2019	11.1	15.7	21.3	27.1	25.1	21	20.2
Rainfall	2018	25.8	41.1	12	0.3	2.5	0	16.2
	2019	99.8	30.1	24.9	5.1	0	0	26.6
Relative								
humidity	2018	60	57	44	28	36	33	43
	2019	80	67	55	18	19	21	43.3
Solar								
watshs	2018	196.7	215.7	307.2	259.5	351.5	330.8	272.4
	2019	157.2	259.6	288.1	351.6	352.3	328.2	272.8

This experiment was laid out in factorial arrangement based on randomized complete block design with three replications. The row to row distance was 33cm. Also, plant to plant distance was 10 and 6.7 cm, for 30 and 45 plant.m⁻² respectively. Seed depth was 3-4 cm from the soil surface in dry soil conditions. After seed planting, irrigation was done for 10 days daily until emergence due to the small seed size (1000 grain weight about 2.5g). In follwed, irrigation was once a week until plants establishment, and after the plant establishment, the flood irrigation was used. The cultivated seeds were three times the desired

density, and after germination (about two weeks after germination) thinning operation was performed. Handel Fuka was used for weed removal.

Leaf dry weight components (kg.ha^{-1}) were determined using 7 plants per plot. A leaf area gauge device was used to measurement of leaf area. The plant leaves were separated and and dried at 72°C for 48 hours after the leaves and stems were placed in a paper bag, then leaves dry weight was measured. In this experiment also, photosynthetic pigments were measured by Arnon (1949) using a spectrophotometer. The leaves elements including nitrogen, phosphorus, iron, copper and zinc were measured. The iron, copper and zinc were measured using an atomic absorption spectrometer. The nitrogen was measured using Kjeldal method. Phosphorus was measured using a spectrophotometer and potassium was measured using a flame photometer (Ali Ehyaei, 1999).

Statistical analysis was performed using SAS statistical software and the means comparison performed using LSD test at 5% probability level (SAS, 1989).

RESULTS AND DISCUSSION:

Dry leaf yield

The combined analysis of variance table showed that the effect of year, planting date, plant density, interaction effect of planting date and plant density and the interaction effect of planting date and year were significant on Azivash dry leaf yield at 1% probability level (table 2). The of means comparison results showed that the maximum Azivash dry leaf yield was obtained in June 1 and May 18 at 45 plant.m^{-2} plant density treatment in rate of 1425 and $1466.1 \text{ kg.ha}^{-1}$ respectively. However, in 30 plant.m^{-2} plant density treatment the highest dry leaf yield was observed on May 18 and June 1 (1217.8 and $1278.2 \text{ kg.ha}^{-1}$ respectively). The minimum azivash dry leaf yield was recorded in both planting 30 and 45 plant.m^{-2} plant density treatments were recorded in July 18, which was 570.5 and 388.9 kg.ha^{-1} respectively (table 3).

Table 2- The combined analysis of variance for effect of year, planting date and plant density on measure traits of Azivash

S.O.V	DF	dry leaf yield	N	Zn	P	Fe	Cu	chlorophyll- a	chlorophyll- b	carotenoid
Year (Y)	1	485280**	0.02**	2.57*	20283**	1.37ns	0.51ns	0.614**	0.269**	0.096**
Error-a	4	1396	0.08	2.77	11201	71.97	2.36	0.499	0.221	0.077
Planting date (A)	4	1572216**	11.08**	11.56**	409821**	2238.9**	0.2ns	0.336**	1.481**	0.52**
Y*A	4	35053**	0.18**	1.9ns	2949ns	15.68ns	0.12ns	0.036ns	0.015ns	0.005ns
Plant density (B)	1	495405**	0.7**	10.2**	150311**	43.29*	1.61ns	1.926**	0.854**	0.295**
Y*B	1	5762ns	0.01ns	1.19ns	2245ns	0.04ns	0.09ns	0.002ns	0.0001ns	0.0001ns
A*B	4	44884**	0.03**	0.32ns	1947ns	16.05*	0.12ns	0.044*	0.017*	0.005ns
Y*A*B	4	6255ns	0.007ns	1.06ns	582ns	5.99ns	0.01ns	0.0001ns	0.0008ns	0.002ns
Error-b	36	1942	0.008	0.62	1492	8.98	0.5	0.037	0.016	0.006
CV(%)		7.3	3.6	4.1	4.8	5.2	9.2	6.3	5.6	5.6

Ns, ** and *: non significant, significant at 1 and 5 % level respectively.

Table 3- The mean comparison for effect of year, planting date and plant density on measure traits of Azivash

year	planting date	dry leaf yield (kg.ha ⁻¹)	N (%)
2018	01-May	944c	2.01d
	18-May	1643.6a	3.22a
	01-Jun	1508.1a	3.34a
	01-Jul	1140.8b	2.54c
	18-Jul	497.6d	1e
2019	01-May	827.8c	1.99d
	18-May	1220.1b	2.92b
	01-Jun	1195b	3.54a
	01-Jul	950.1c	2.88b
	18-Jul	461.8d	1.02e

Different letters in each column showed the significant difference at 5 % level.

Based on the results it should be stated that in all planting dates, the higher dry leaf yield was obtained in 45 plant.m⁻² in comparisons with 30 plant.m⁻² plant density treatment, which indicates that 45 plant.m⁻² plant density treatment is more desirable compared to 30 plant.m⁻² plant density treatment in terms of dry leaf yield (table 4). The high variation range (1078 kg.ha⁻¹) for different planting dates at different plant densities indicates the importance of determining of optimal planting date and optimal plant density for the Azivash plant, which can achieved to the highest dry leaf yield by appropriate planting date and desired density (table 4).

The results of mean comparing for interaction effect of year and planting date showed that in the first year of experiment the dry leaf yield was 944 kg.ha⁻¹ at May 1, but planting on May 18 (about 17 days after the first planting date), had the highest dried leaves yield of Azivash (1643 kg.ha⁻¹) and delay planting date untile June 1 the dry leaf yield was decreased (table 3), but this reduction was not statistically significant. In the second year, the highest dry leaves yield was obtained from the two planting dates of May 18 and June 1, but dry leaf yield less than the first year as 300 kg.ha⁻¹. The dry leaves yield was 1140.8 and 950 kg.ha⁻¹ in July 1 for first and second years respectively. These results actually show that when the year is more suitable in terms of climate in this region (higher temperature), the dry leaf yield on the planting date of July 1 at second year had higher dry leaves yield. On the other hand, the amount of yield on the planting date of July 18 shows that planting after July 1 will cause a sharp decrease in dry leaf yield, which will make the cultivation of this plant, had not

economic justification in this planting date. Based on these results, it should be noted that the choice of planting date has a very important effect on the dry leaf yield of Azivash, and since the consumption of Azivash as dry leaves form is very common, therefore any factor that increases dry leaf yield can ultimately help to increase of economic aspects of Azivash. In general, the results show that the range of optimal planting date to achieve optimal dry leaf yield of Azivash in Shirvan region is from middle May to middle June.

The interaction effect of plant density and planting date showed that the dry leaf yield in all planting dates at 45 plant.m⁻² was higher than 30 plant.m⁻², and the highest dry leaf yield was obtained in 45 plant.m⁻² plant density treatment in two planting dates of May 18 and June 1 (table 4). The dry leaf yield of Azivash at July 1 was equal with May 18 and June 1 in 45 plant.m⁻² plant density treatment. In term of effect of plant density on the yield of Azivash in Gorgan region, Ghorbani (2017) reported that in all three irrigation regimes with increasing of plant from 16 to 66 plants per square meter, dry leaves yield was increased lineary in 8 days irrigation irrigation regimen. Also, Ghorbai et al (2014) stated that the highest dry leaves yield of Azivash was founded in May 5 in Gorgan region that was different with present findings. The difference in planting date between the two regions is due to higher temperatures and earlier air warming in Gorgan region compared to Shirvan region.

Table 4. The mean comparison for interaction effect of planting date and plant density on measured traits of Azivash

plant density	plantin g date	dry leaf yield (kg.ha ⁻¹)	N (%)	Zn (ppm)	P (ppm)	Fe (ppm)	chlorophyll -a (mg.g ⁻¹ FW)	chlorophyll -b (mg.g ⁻¹ FW)
45	01-May	975.8c	2.12d	20a	726.3c	58.4a	3.3d	2.2bd
	18-May	1466.1a			889.3a			
	01-Jun	1425a	3.19b	20a	b	69.6a	4.01b	2.67a
	01-Jul	1121.5b	3.61a	20.3a	917.9a	71.5a	4.23a	2.82a
	18-Jul	570.5d	2.85c	18.8b	b	47.2c	3.58c	2.39b
			1.05e	18c	470.4e	40.6d	2.89e	1.93d
30	01-May	970c	1.88d	18.8b	725.3c	53b	3.06e	2.04d
	18-May	1217.8b						
	01-Jun	1278.2b	2.96c	19.1b	949.7a	69.8a	3.64c	2.43b
	01-Jul	969.5c	3.28b	19.8a	938.7a	70a	3.74c	2.49b
			2.69c	17.7c	907.5a	47.5c	3.34d	2.23bd

	388.39						
18-Jul	f	1.01e	17.4c	524.9d	38.7d	2.44f	1.73e

Different letters in each column showed the significant difference at 5 % level.

Leaf nutrients

The results of the combined analysis variance showed that the effect of year was significant on leaf nitrogen, zinc and phosphorus. Planting date had a significant effect on the amount of nitrogen, zinc, phosphorus and iron. The interaction effect of year and planting date was significant only on the amount of nitrogen. The plant density treatment was significant on the amount of nitrogen, zinc, phosphorus, and iron. The interaction effect of planting date and plant density was significant on both nitrogen and iron content of Azivash leaf. The interaction of year and planting date and also tripartite interaction of year, plant density and planting date had no significant effect on any of the measured leaf nutrient traits (table 2).

The interaction effect of year and planting date showed that leaf nitrogen on planting date of June 1 were 3.34 and 3.54%, in first and second years respectively, which was statistically at the same level. (The highest amount of nitrogen), but the amount of nitrogen in the first year for May 18 was same to July 1. On the contrary, the amount of nitrogen for July 1 was higher in first year compared to second year (table 3). Azivash is heat-loving plant, and it seems that differences between two years were observed due to temperature difference between them, so that the higher relative temperature in the first year at May and June has provided the conditions for more nitrogen production.

Based on the mean comparison results for interaction effect of planting date and plant density the amount of zinc, nitrogen, phosphorus and iron in Azivash leaves at plant.m^{-2} was higher than 30 plant.m^{-2} (table 4). In other hand, the amount of leaf nutrients reduced with reduction of plant density lower 45 plants per square meter. The highest amount of zinc in both 30 and 45 plant.m^{-2} densities was observed on July 1, which had no significant difference with May 1 and May 18 at the 5% probability level. The lowest amount of leaves zinc was observed in 30 plant.m^{-2} plant density treatment in July 1 and July 18 planting dates treatment as 17.7 and 17.4 ppm respectively (table 4). The amount of Azivash leaf nitrogen was changed with changes of planting date and plant density, so that the highest amount of nitrogen was observed at 45 plant.m^{-2} plant density treatment and planting date of June 1, which is equal to 3.61%, and was significantly higher than other planting dates. The lowest amount of Azivash

leaf nitrogen was observed in May 18 planting date in 30 and 45 plant.m⁻² plant densities in rates of 1.01, and 1.05% respectively (table 4).

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The highest amount of leaf phosphorus was recorded in 45 and 30 plant.m⁻² and the planting dates of May 18, June 1 and July 1, and the differences between these treatments were not significant for leaf phosphorus. This indicates that is, planting dates of May 18, June 1 and July 1 and also plant density had no significant effect on the leaf phosphorus of Azivash, but the amount of leaf phosphorus of Azivash decreased in the planting dates of May 1 and July 1, which was 48% lower than June 1 planting date (table 4).

Based on the results maximum amount of leaf Iron was measured in June 1 at 45 and 30 plant.m⁻² plant densities in rates of 71.5 and 70 ppm respectively. The differences between May 18 and June 1 planting date was not significant in 30 and 45 plant.m⁻² plant densities for leaf Iron (table 4). In general, based on the present results, it should noted that both plant density and planting date have significant effects on leaf nutrients, so that there was 15 to 50% difference between optimal and unfavorable planting date. In really, it was agueded that because the amount of nutrients in Azizush leaves indicates the quality of its leaves, by choosing the desired plant density and planting date, it is possible to increase the Azizosh leaves quality. On the other hand, amount of nutrients in the leaves is very important due to fresh cunsomption of Azizosh leaves.

In general, based on the results of this experiment, it can be stated that both delaying and early planting date impairs the nutrients uptake in Azivash plant and ultimately causes a lack of nutrients in the Azivash leaves and reduction of leaves quality. Therefore, selection of optimal planting date increases the quality of Azivash leaves. Also, the results showed that planting date treatment had a greater effect on nutrient of Azivash leaves in comparison with plant density (table 4). The researchers documented that change in planting date result to changes the plants' nutrient availability, so that delay or early planting dates causes different nutrients uptake compared to optimal planting date (Soheili et al., 2010). It is also stated that planting date had has a significant effect on growth, development, nutrient uptake and plant production during the growing season due to changes in day length, temperature and relative humidity and is one of the most important effective managing factors in the crop production (Khichar and Niwas, 2006). In an experiment, the effect of planting date was significant on essential oil yield and nutrient content of cumin leaves (nitrogen and phosphorus) was

reported to be significant (Ghorbani et al., 2009). It seems that under delay in planting date the essential oils and leaves nutrients reduced due to unfavorable growing conditions, especially in the late stages of growth and exposure to heat, as well as reducing the length of the plant growth period. These researchers stated that cumin is sensitive to photoperiod and delay in planting date reduces the optimal growing season (Soheili et al., 2010).

Photosynthetic pigments

Based on the results of combined analysis of variance, the effect of year, planting date and plant density was significant on chlorophyll a, chlorophyll b and carotenoids of Azivash leaves. Also the combined effect of planting date and plant density was significant on chlorophyll a and b (table 2). Based on the results of combined mean comparison, chlorophyll a and b in both plant densities increased from May 1 to June 1 then decreased. In fact, based on the results of this experiment, it can be stated that the chlorophyll a and b first increased then decreased after optimal level (which in this experiment is June 1) (table 4). This was observed in both 30 and 45 plants per square meter and 45 plant.m⁻², but the important point is the higher chlorophyll a and b content in 45 plant.m⁻² in comparison with 30 plant.m⁻² at five planting date treatments (table 4). In 45 plant.m⁻² treatment the highest chlorophyll a and b were obtained in June 1 planting date (4.23 and 2.82 mg.g⁻¹ FW respectively) and the lowest content of chlorophyll a and b were obtained in July 18 (2.89 and 1.93 mg.g⁻¹ FW respectively). However, in 30 plant.m⁻² treatment the highest chlorophyll a and b were obtained in June 1 planting date (3.74 and 2.49 mg.g⁻¹ FW respectively) and the lowest content of chlorophyll a and b were obtained in July 18 (2.44 and 1.63 mg.g⁻¹ FW respectively) (table 4). Based on the results, the main optimal planting date after July 1 was May 18 for chlorophyll content.

Table 5- Mean comparison for effect of planting date on carotenoid content of Azivash leaf

Planting date	Carotenoid (mg.g ⁻¹ FW)
May 1	1.25b
May 18	1.51a
June 1	1.57a
July 1	1.37b
July 18	1.05c

Different letters in each column showed the significant difference at 5 % level.

Regarding the carotenoid content, the results of the mean comparison showed that the maximum amount for carotenoid was measured in May 18 (1.51 mg.g⁻¹ FW) and June 1 (1.57 mg.g⁻¹ FW), which was higher than other planting dates significantly. The lowest carotenoid content was obtained in July 18 as 1.05 mg.g⁻¹ FW (table 5).

It was documented that the main reason for the effect of planting date on different plant traits is changes in temperature, humidity and other plant sources, which causes severe and mild environmental stresses for the plant by changing the planting date. In other words, favorable and unfavorable planting dates affects on plant characteristics by changing of environmental conditions (Valadabadi et al., 2011). In this regard, it is stated that temperature, water status and soil fertility changed by varying of planting date and affect on plant traits such as leaf development, leaf area duration, production of photosynthetic materials and photosynthetic pigments. Although these mainly observed in day length sensitive genotypes, also occur in indifferent day length plants (Farias et al., 2007).

In accordance with present results, it has shown that the chlorophyll a and b and carotenoids are the main effects of planting date and cultivar in fennel; so that the pigments increased at optimal planting date and excellent cultivar (Barzegar et al., 2013). In this regard, Dariny et al. (2013) reported that the amount of photosynthetic pigments and dry matter was higher in the planting date of August 23 (optimal planting date) compared to other planting dates. They argued that the main reason for this phenomenon is exist of sufficient time for production of photosynthetic material.

Table 6- Mean comparison for effect of year on measured traits of Azivash

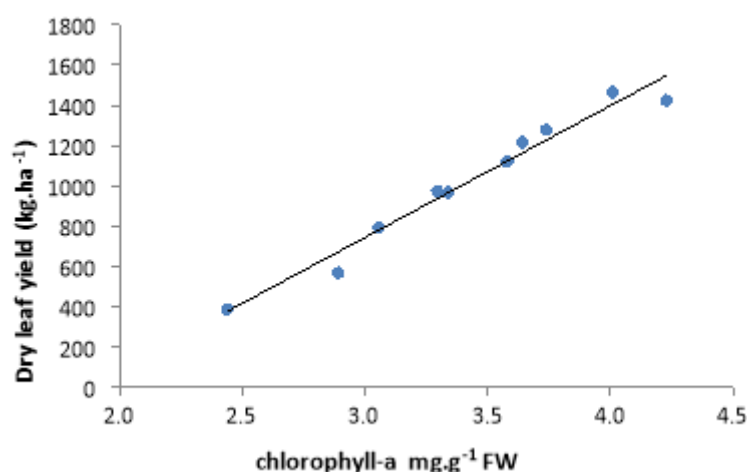
Year	Zn)ppm(	P)ppm(	Chlorophyll- a)mg.g⁻¹ FW(	Chlorophyll-a)mg.g⁻¹ FW(	carotenoid)mg.g⁻¹ FW(
2018	19.2a	811.8a	3.52a	2.35a	1.39a
2019	18.8b	775.0b	3.32b	2.21b	1.31b

Different letters in each column showed the significant difference at 5 % level.

Based on the results in the first year of experiment the amount of photosynthetic pigments and nutrients (zinc and phosphorus) in Azivash leaves were higher in comparison with second year. It was seems that the optimal climatic conditions in the first year (higher

temperatures based on table 1) is the main reasons for higher growth and nutrients uptake in Azivash plant rather than the second year. Therefore, the amount of photosynthetic pigments (chlorophyll a, b and carotenoid) and also nutrients such as phosphorus and zinc were significantly higher in the first of experiment (table 6).

Figure 1 shows the relationship between dry leaf yield and measured traits (chlorophyll a, nitrogen, phosphorus and iron percentage). The results showed that with increasing of chlorophyll a, nitrogen, phosphorus and iron percentage the leaf dry yield increased linearly, so that increase of 1 mg.g^{-1} FW chlorophyll a result to increasing of leaf dry yield by 635.4 kg.ha^{-1} . Regarding the nitrogen percentage, the leaf dry yield of Azivash increased by 377.8 kg.ha^{-1} with increasing of leaf nitrogen as rate of 1% (figure 1). The former researchers documented that the relationship between leaf nitrogen and photosynthetic pigments is significant positive and it is obvious that increasing of leaf photosynthetic pigments or leaf nitrogen result to leaf photosynthesis and dry matter production, and ultimately this increases the dry leaf yield of Azivash. The results of Figure 1 also showed that by increasing 1 ppm in the amount of leaf phosphorus, the dry leaf yield of Azivash increased by 1.79 kg.ha^{-1} and with increasing of leaf iron as 1 ppm, the dry leaf yield of acivash increased by 24.2 kg.ha^{-1} . This indicates that any factor increasing nutrients uptake result to increasing of dry leaf yield of Azivash. .



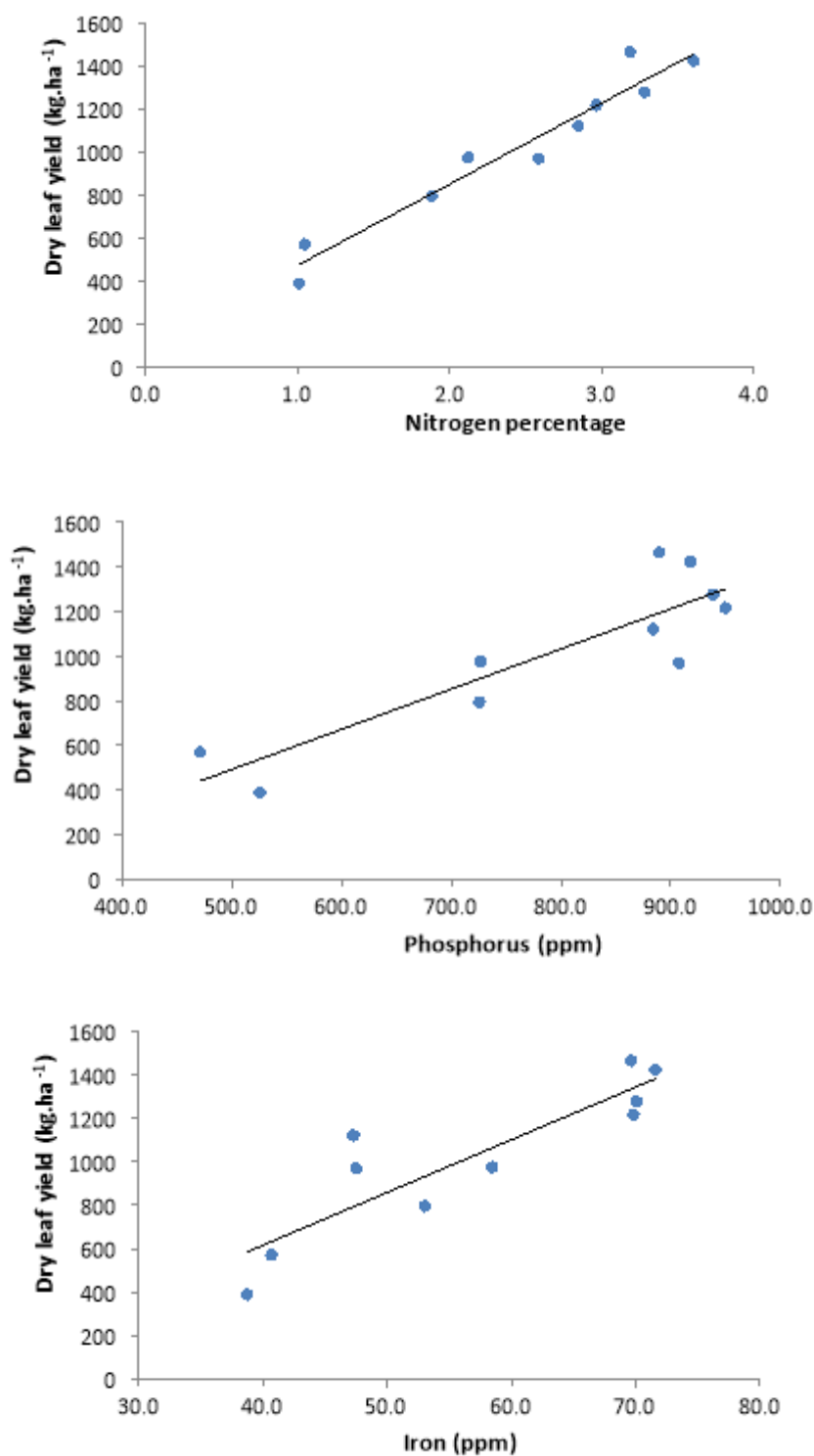


Figure 1. Regression relationship between measured traits

CONCLUSION:

The results of present experiment showed that the effect of year, planting date, plant density and the interaction effect of planting date and plant density were significant on the studied

traits. Based on present results, the leaf production and quality of azivash in 2018 was better than 2019. Also, according to these results, there was higher amount of dry leaf yield and photosynthetic pigments in 45 plant.m⁻² treatment compared to 30 plant.m⁻² treatment. Also the highest dry leaf yield and photosynthetic pigments was founded in June 1 planting date compared to other dates in Shirvan region. In general, based on the results of this experiment, it was noted that the planting date and plant density has a great effect on dry leaves yield of Azivash as the most important trait in this plant. However, leaf quality of Azivash was influence by planting date and plant density, so that maximum amount of nitrogen, zinc and iron in Azivash leaf were observed in both plant densities on June 1 planting date. However, it should be stated that planting date and plant density are very important to achieve maximum dry leaf yield and better quality.

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