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Evaluation of maximum light absorption and light extinction coefficient in different levels of nitrogen and wheat cultivars

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ABSTRACT

The experimental was split plot in a randomized complete block design with three replications. In this experiment, different levels of nitrogen in the main plots included four levels (0, 50, 100 and 150 N) $kg.ha^{-1}$ urea and wheat varieties, including cultivars, Sepahan and SW were placed in the subplots. Results showed that nitrogen fertilizer and cultivar were significant effects on maximum light absorption. Fertilizer treatment of 150 $kg.ha^{-1}$ nitrogen resulted in maximum light absorption compare to other treatments. Maximum light absorption was related to Pishtaz cultivar. The interaction between nitrogen and cultivar on maximum light absorption was significant at 5% probability level. Treatment of 150 $kg.ha^{-1}$ nitrogen with Pishtaz cultivar had the highest average of light absorption. As well as the calculated extinction coefficient of light during the growing season to control treatment, 50, 100 and 150 $kg.ha^{-1}$ nitrogen was respectively equal to -0.4675, -0.4794, -0.4858 and -0.495 and for Pishtaz, Sepahan and SW cultivars was -0.488, -0.4618 and -0.4504 respectively. Results indicate that in order to achievement to maximum light absorption, 150 $kg.ha^{-1}$ nitrogen fertilizers together with Pishtaz cultivar at the condition similar to this study seems to be appropriate.

Key words: Wheat, K, Fertilizer and Pishtaz cultivar.

1- INTRODUCTION

Wheat (*Triticum* spp.) is a cereal grain, originally from the levant region of the near east and ethiopian highlands, but now cultivated worldwide. In 2010, world production of wheat was 651 million tons, making it the third most-produced cereal after maize (844 million tons) and rice (672 million tons). Wheat was the second most-produced cereal in 2009; world production in that year was 682 million tons, after

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maize (817 million tons), and with rice as a close third (679 million tons) (Robert et al., 2000). Light sources are necessary for plant growth. Light extinction coefficient K is a coefficient that represents the amount of light the plant is reduced. Light or radiation extinction coefficient decrease light penetration into the canopy is a concept that expresses the plants so that the leaves of the upper canopy should shoot angles less than K are greater than the horizontal leaves (Major and Otegu, 1996). Qalambor et al., (1998) stated that nitrogen fertilizer increased light absorption by plant leaves; the effect of nitrogen on the yield reduction due to reduced leaf area index and light, there for radiation use efficiency is depended to nitrogen amount. Some researchers believe that the leaf nitrogen distribution in a canopy pattern is similar light distribution; the canopy photosynthesis reaches its maximum. The distribution patterns of nitrogen allocation to leaves are more exposed and thus the amount of photosynthesis per unit leaf area and canopy were optimized (Blue et al., 1992). Differences in canopy structure by the light extinction coefficient (k) of the Act Lambert - Beer is described, along with the LAI may differ due to different species and genotypes are more factors in absorption and light use efficiency (Kiniry et al., 1998). So try this experiment are evaluation of maximum light absorption and light extinction coefficient in different levels of nitrogen and wheat cultivars.

2- MATERIALA AND METHODS

This experiment in year 2011-2012 Agricultural Research Farm Branch (Isfahan), located at latitude 32 degrees Khatoon Abad village 40 minutes north and longitude 51 degrees 48 minutes East, with an altitude of 1555 m. The sea level was implemented. The area under a very hot arid climate classification coupons and hot dry summers and cold winters are part.

Table 1- Physical and chemical properties of experimental field soil

Clay (%)	Soil (%)	Silt (%)	K (%)	P (%)	N (%)	OC (%)	pH	EC (ds)	Depth of soil (cm)
39	22	39	415	36	0.12	1.71	7.9	3.6	0-30
41	24	35	428	36	0.10	1	7.9	3.48	30-60

The experimental split plot in a randomized complete block design with three replications. In this experiment, different levels of nitrogen in the main plots included four levels (0, 50, 100 150 N) $kg.ha^{-1}$ and wheat cultivars including, Sepahan, Pishtaz and SW were placed in the subplots. Elements needed to strengthen land and plant fertilizer according to soil test results of 100 kg /ha fertilizer urea (46% N) was on the ground before planting. 300 kg of nitrogen per hectare as well as the transition from vegetative to reproductive roads were down. November 14, 2012 and the planting density of 400 plants (m^2). Each sub-plot consisted of 10 lines with a planting distance of 15 cm and a length of 5 meters and implants lines in order to prevent any water mixing between the main plots 1.5 m in distance, was considered significant.
Photometer for measuring light absorption was used of the device model (TES-1334 A) Lotron manufactured in Taiwan. To this end one day before measurement of dry matter and leaf area, in one square meter of leaf area was measured at the same location of the sample with respect to the marginal measure photo synthetically active radiation with a wavelength between was 400 and 700 nm performed. So every 15 days between the hours of 11 pm to 13 actual measurements took place under a clear sky and sunny. Light measurements was measured at each measuring 20 canopy up and 30 canopy upper parts at

the down of the vegetation cover and then were recorded measure out the average of high and low canopy position. Light extinction coefficient was calculated using the Beer-Lambert law.

$$ln\frac{I}{I_0} = -k\ LAI$$

The formula uses factors during the growing season and requires no analyses.

3- RESULTS AND DISCUSSION

Effect of nitrogen on maximum light absorption in 5% level was significant (Table 2). Most of the absorption of light in the canopy was obtained in 150 $kg.ha^{-1}$ nitrogen treatment the non-significant difference between treatments was $kg.ha^{-1}$ nitrogen treatment and lowest in canopy light absorbance of the control treatment (Table 3). The results indicated is that nitrogen fertilizer caused an increase in light absorption by plant leaves. In many plants, a positive relationship between photosynthetic capacity and leaf nitrogen concentration is observed (Wang et al., 1985).

Changes in light absorption at different fertilizer treatments during the growing season, it is suggested that Control treatment, the lowest percentage in light compared to other treatments and increased to 150 $kg.ha^{-1}$ nitrogen was observed, a significant increase in the light absorption (Fig. 1). This reaction produced the highest LAI by fertilizer treatment of 150 $kg.ha^{-1}$ nitrogen. So that leaves an increased level of light absorption, have been achieved the highest percentage of light absorbed by the fertilizer treatments of 150 $kg.ha^{-1}$ nitrogen. Felt et al (1996) also stated that the increase in leaf area index, light absorption of the canopy increases. Some researchers believe that the leaf nitrogen distribution in a canopy light distribution pattern is similar; the canopy photosynthesis reaches its maximum. The distribution pattern of nitrogen allocation to leaves is more exposed and thus the amount of photosynthesis per unit leaf area and canopy were optimized (Shahsavar and Safari, 2005; Kobata, 1992). Effect of cultivar on maximum light absorption in 5% level was significant (Table 2). Most of the on light absorption was in the canopy by Pishtaz cultivar and the lowest percentage SW cultivar (Table 3). The results show that the Pishtaz cultivar the higher adsorption capacity of greater light absorption can be more LAI compared to the other cultivars. Changes in light absorption of different cultivars during the growing season, it is suggested that the leading figure of 179 days after planting, the more light absorption than other varieties during the growing season (Fig. 2). Because these reactions leading to higher LAI during the growing season than other cultivars.The interaction between nitrogen and cultivar on maximum light absorption was significant at 5% probability level (Table 2). Treatment of 150 $kg.ha^{-1}$ nitrogen with Pishtaz cultivar had the highest average of light absorption (Table 4). The projected harmony with the leading figures of the absorbance changes in LAI during the growing season, there is a cultivar that confirms the testing. Canopy characteristics such as leaf angle and light extinction coefficient of the factors that affect the rate of absorption of light in the canopy are (Kochaki et al., 1988). The difference between is observed the cultivars in the rate of absorption.The calculated extinction coefficient of nitrogen fertilizer during the growing season in the treatment of conditions is shown Figure 2. The results showed that in the control (control) concentration (k=-0.4675) respectively, with increasing nitrogen rate of 50 $kg.ha^{-1}$ nitrogen increased extinction coefficient (k=-0.4794), increasing to 100 $kg.ha^{-1}$ nitrogen increased extinction coefficient (k=-0.4858), then the use of higher levels of nitrogen, 150 $kg.ha^{-1}$ nitrogen reached its peak in the extinction. Results show that consumption of 150 $kg.ha^{-1}$ nitrogen produced the highest LAI higher light absorption and light extinction coefficient of the canopy is the absolute maximum. LNI/IO=-3 represents 95% light absorption and 5% light transmission to the floor vegetation cover so LAI contrast, the LAI is critical that the rate for the control and 50, 100 and 150 $kg.ha^{-1}$ nitrogen equivalent, 6.4171, 6.2578, 6.1753 and 6.060 which indicates that the reaction with increasing N up to 100 $kg.ha^{-1}$ nitrogen, the LAI is critical to reducing decreased and then increased with nitrogen rate of 150 $kg.ha^{-1}$ nitrogen increases. Qalambor et al., (1998) reported that nitrogen increases the absorption of light by leaves is therefore consume more nitrogen fertilizer plant is the light extinction of the present study are in compliance.The extinction coefficient calculated during the growing season in several varieties, calculated is shown in Figure (4). The results indicate that the light extinction coefficient of the SW cultivar (k=-0.4504), respectively, and the number Sepahan (k=-0.4618) and a Pishtaz cultivar in comparison with the highest light extinction coefficient other varieties of the same (k=-0.488), respectively. LAI critical SW, Sepahan and Pishtaz, respectively was 6.0606, 6.4963 and 6.1475. The leading figure of 95%, with the highest values of LAI is able to absorb light. This response indicates that the photo extinction coefficient of the different varieties of plants is influenced by genetics.

4- CONCLUSION

Results indicated that in order to achievement to maximum light absorption, 150 $kg.ha^{-1}$ nitrogen fertilizers together with Pishtaz cultivar at the condition similar to this study seems to be appropriate.

Table 2- Analysis of variance of present absorbed light

		Mean square
SOV	df	Absorbed light (%)
Replication	2	21
Nitrogen	3	277.26**
Ea	6	14.10
Cultivar	2	105.30*
Nitrogen×Cultivar	6	84.31*
Eb	16	23.92

**,* are significant respectively at level 1 and 5 percent

Table 3- mean morphological characteristics of different wheat cultivars under different levels of nitrogen fertilizer

SOV	Absorbed light (%)
Nitrogen	
0	81.40c
50	87.26b
100	90.80ab
150	94.43 a

Genotype	
SW	85.87b
Sepahan	87.85ab
Pishtaz	91.70 a

Means in each column ,followed by at least one similar letter are not significantly different level-using Duncan's Multiple Range Test

Table 4- Comparison mean of present absorbed light of the interaction of different wheat cultivars under different levels of nitrogen fertilizer

SOV		Absorbed light (%)
Nitrogen	Cultivar	
0	SW	77.90e
0	Sepahan	88.50bcd
0	Pishtaz	77.80e
50	SW	86.33cde
50	Sepahan	80.90de
50	Pishtaz	94.57abc
100	SW	87.63bcd
100	Sepahan	88.40bcd
100	Pishtaz	96.37ab
150	SW	91.63abc
150	Sepahan	93.60abc
150	Pishtaz	98.07a

Means in each column ,followed by at least one similar letter are not significantly different level-using Duncan's Multiple Range Test

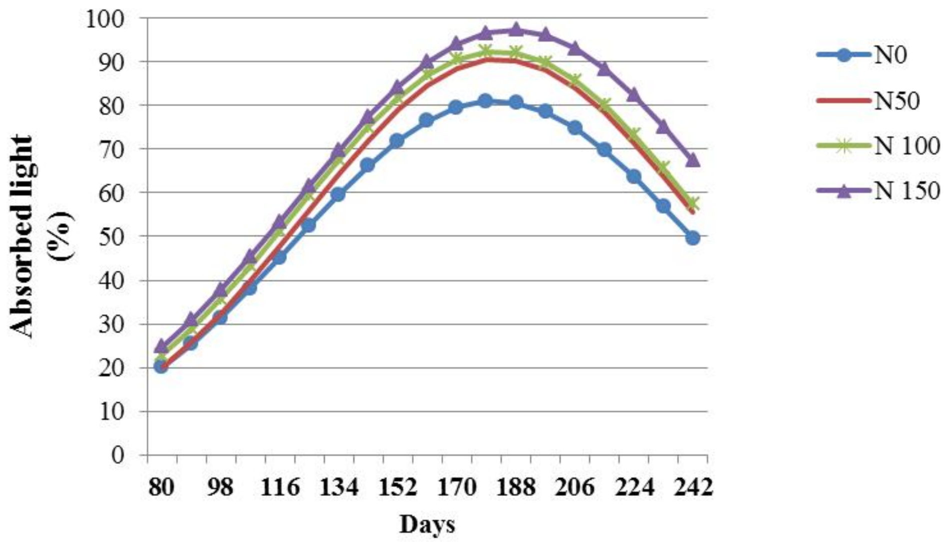


Figure 1. The effect of different nitrogen levels the variation rat of maximum light absorption

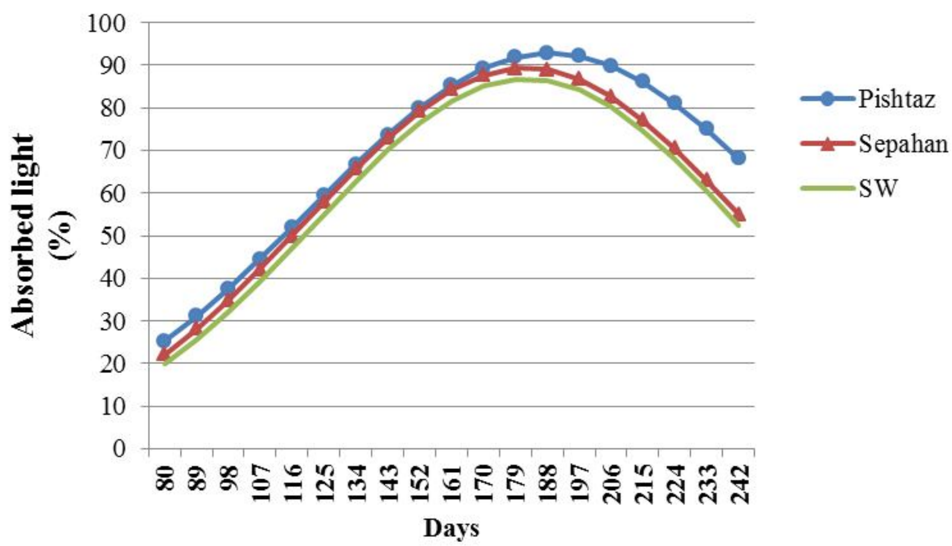
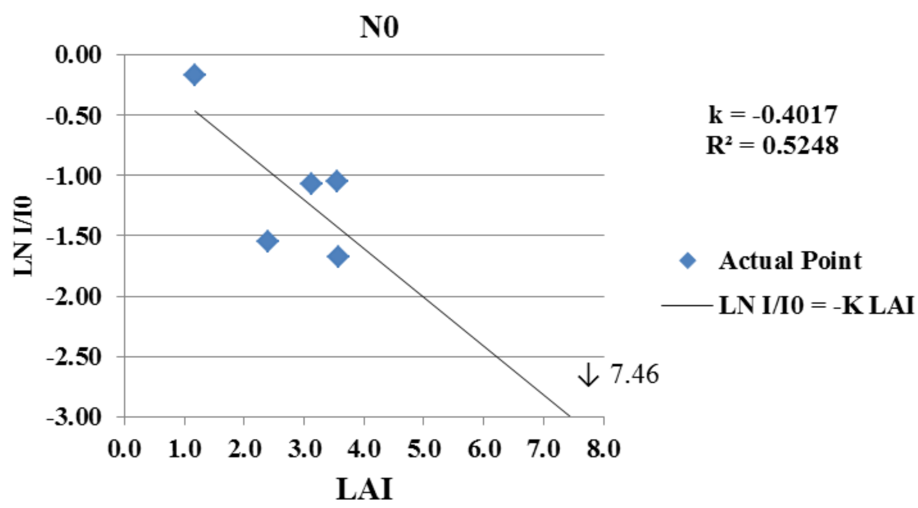
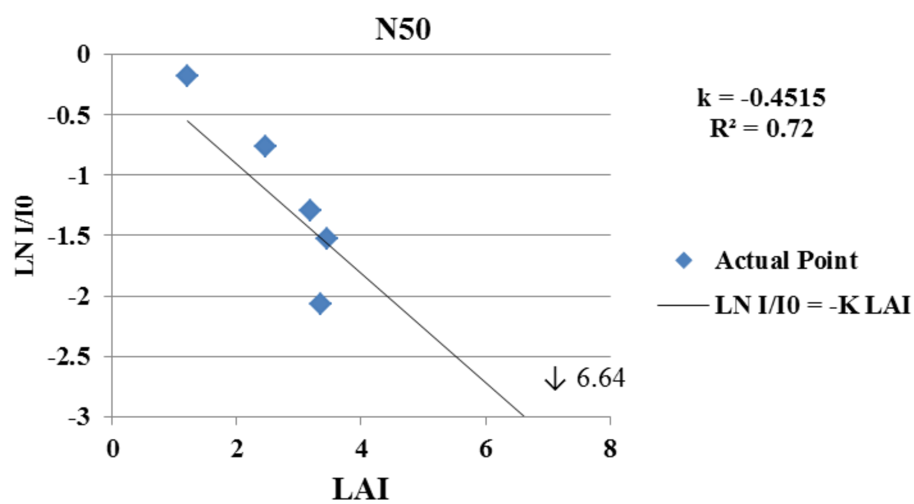
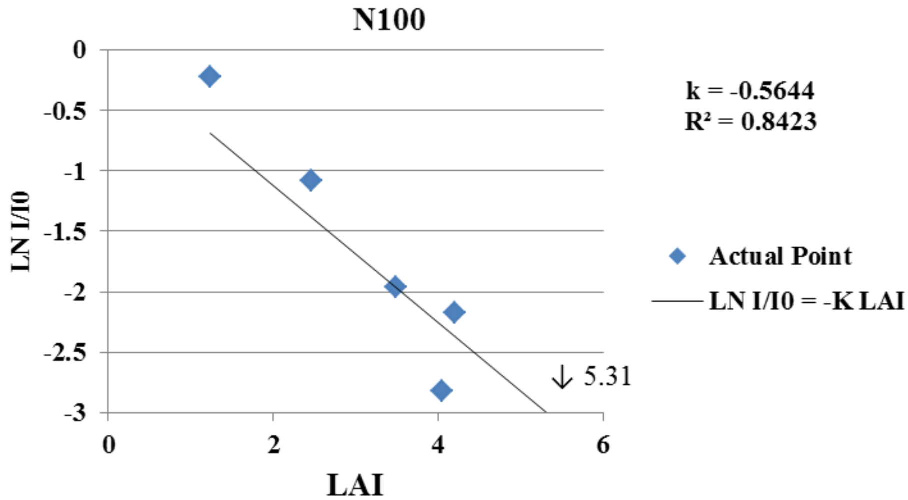


Figure 2. The effect of different cultivars the variation rat of maximum light absorption


N0
k = -0.4017
R² = 0.5248
Actual Point
LN I/I0 = -K LAI
7.46
LN I/I0
LAI
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0


N50
k = -0.4515
R² = 0.72
Actual Point
LN I/I0 = -K LAI
6.64
LN I/I0
LAI
0
-0.5
-1
-1.5
-2
-2.5
-3
0 2 4 6 8



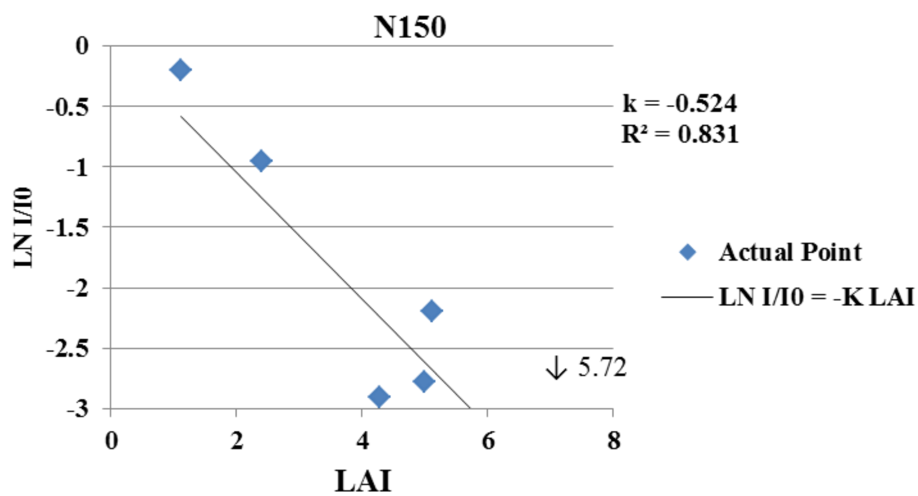


Figure 3. The relationship of LN(I/I0) and LAI amount affected by different nitrogen levels

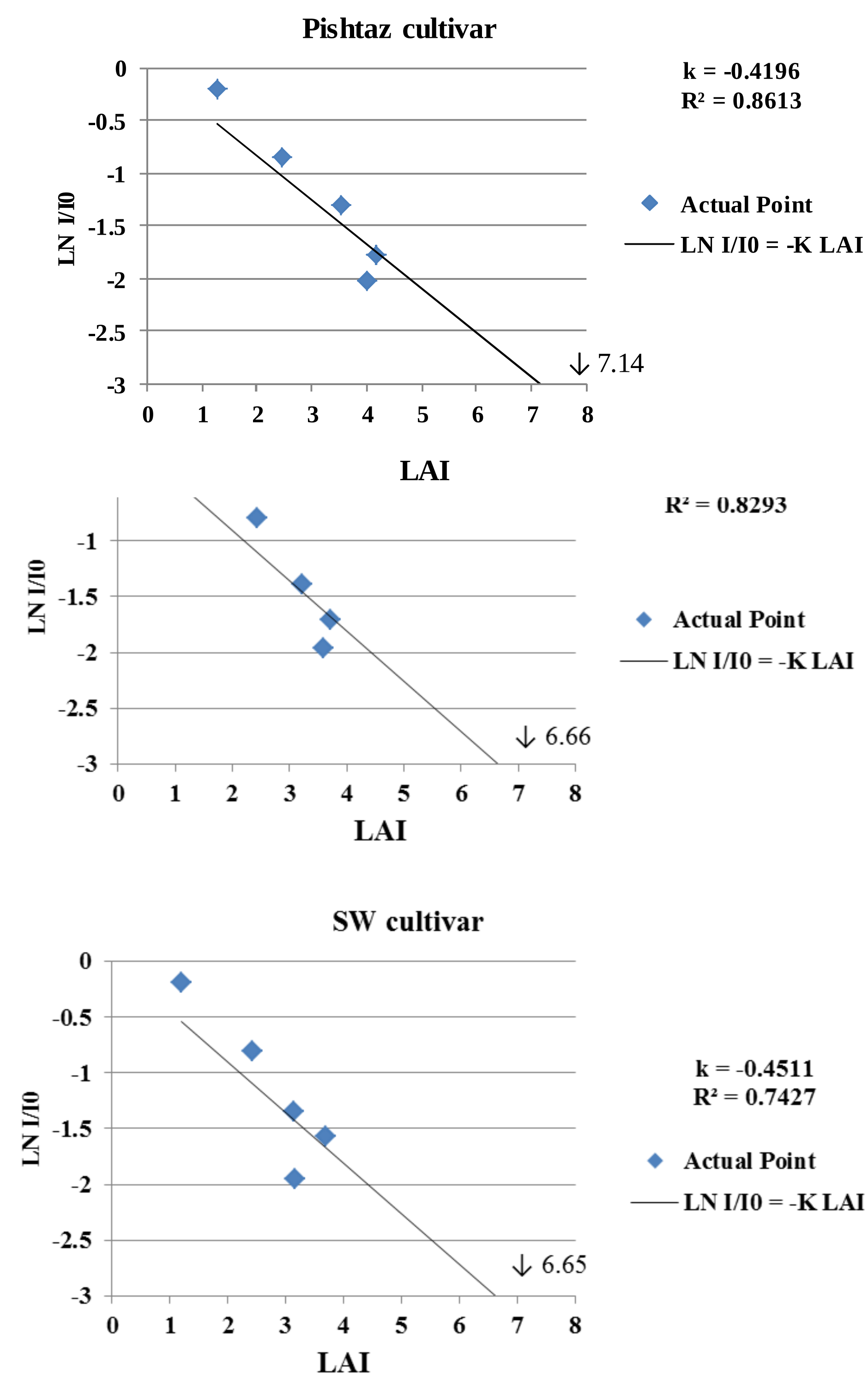


Figure 4. The relationship of LN(I/I0) and LAI amount affected by different cultivars

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