Original Research Article

Investigating of variation of some of morphophysiological indices of lambsquarters (*Chenopodium album* L.) in competition with corn (Zea mays L.)

ABSTRACT

In order to study the morphophysiological characteristics of lambsquarters in competition with corn, an experiment was conducted in Varamin, Iran in 2012. The experiment was conducted in a randomized complete block design with 3 replications and factorial arrangement. The experimental treatments included the relative time of lambsquarters emergence (same time emergence with corn, in the 2-3 stage corn and 5-6 leaves of corn), and total lambsquarters density (5, 10 and 15 plants per meter row equals 6.6, 13.3 and 20 Plant per square meter). Also, with the same treatment combination, lambsquarters were cultivated in pure and non-competitive conditions. The results showed that the delay in the time of lambsquarters emergence reduced its competitive ability against corn. Investigating the effects of competition on height, leaf area and final dry matter accumulation, it was found that the height difference did not differ significantly between the competition and monoculture (with the exception of emergence in 5-6 leaves, which showed a decrease of 24%) and in contrast to other traits, there was a significant difference between them and the highest level of leaf and dry matter was observed at the same time. So that emergence in 5-6 leaves of corn, reduced 63 and 60 percent of maximum leaf area and total dry matter in competition and 40 and 51 percent in monoculture mode compared with same time emerging with lambsquarters.

Keywords: *lambsquarters, Corn, Morphophysiological Indices.*

1. INTRODUCTION

Investigating the competitive strategies of weed growth in order to integrate the ecological principles of weeds with the management of these factors is very important [1]. On the other hand, the complexity of the interaction effects of plant growth has made it difficult to develop integrated weed management practices [2]. Despite the use of herbicides over the last century, not only the species diversity and weed density have not decreased, but the increase of species diversity and weed density continue in many parts of the world. This can be attributed to the resistance of weed species to herbicide in the fields [3]. Currently, chemical control of weeds is the most important method in weed management. In 1990, for example, in the United States, 92 percent of the land allocated to corn was treated with herbicides [4]. Herbicide use at this level has caused a lot of worries, especially regarding surface and groundwater contamination. By presenting the integrated management plan for weeds, the main policies for reducing pesticide use (in terms of levels and levels of consumption) have been replaced by old patterns of weed management [4].

Lambsquarters (*Chenopodium album* L.) is a broad-leaved weed and one-year-old spring from the Chenopodiaceae family. This herb has been introduced in 40 world crops such as sugar beet, soybean, corn and some cereals as weeds

[5]. According to the available reports, each plant could produce over 72,000 seeds [5]. For this reason, in many agricultural lands of the world, it has a significant share in the composition of the seed bank [6]. One of the methods that is considered in the integrated management of weeds is the use of competition to increase the crop competition ability and weaken the weed during the growing season in the presence of weed [7]. In this regard, identification Factors involved in competitive ability of crop and weed can lead to optimum use of competition in sustainable management of weeds. The study on the effect of fodder weed (*Setaria viridis* L.) emergence on the corn field showed that if the emergence of weed is delayed until the 5th leaf stage of corn, the amount of biomass decreases from 73 to 95% [8]. Rohrig and Stotzel [9] study on the effect of competition between two bean and cauliflower plants on the morphological characteristics of salmonella showed that the weeds to increase light absorption and shade avoidance under the conditions of competition with the above two crops, longitudinal growth and Heightens his height. In addition, it has reduced the amount of respiration in the leaf. The same study showed that under conditions of competition, the transfer of material from the roots, stems and petioles is not affected by competition. According to the mentioned studies, recognizing the different effects of crops and weeds in the conditions of competition and the changes that have been made on weed and weed indices in these conditions, in addition to understanding the principle of competition physiology, the establishment of the principles of integrated management of weed (IWM) and planning Behavior will be beneficial.

2. MATERIAL AND METHODS

In order to investigate the morphological and physiological characteristics of lambsquarters in competition with corn, an experiment was conducted during 2012 in the research field of the Plant Protection Research Department in Varamin. The experiment was conducted as factorial in a randomized complete block design with three replications. The experimental treatments included the relative time of lambsquarters emergence (same time emergence with corn, in the 2-3 stage corn and 5-6 leaves of corn), and total lambsquarters density (5, 10 and 15 plants per meter row equals 6.6, 13.3 and 20 Plant per square meter). Also, with the same treatment combination, lambsquarters were cultivated in pure and non-competitive conditions. Before plowing, the soil of the experimental farm was sampled and subjected to chemical analysis. Based on the results of the experiment, the fertilizer soil was considered to be equivalent to 114 kg of pure nitrogen, 11.51 kg of phosphorus per hectare. In autumn, each year after a semi-deep plowing and two times the disc was prepared in spring. Then there was a barrel and stacks of 75 centimeters. In addition, 90 kg of urea fertilizer was added to the ground in an 8-7 leaf corn. The corn cultivar was Single Cross 704 which was cultured on rows at intervals of 20 cm. Seeds were collected in the year before corn fields in varamin. In order to break the dormancy, the seed were kept at -2 ° C for 3 months. Seeds were cultured on both sides of corn rows with high density, to ensure that the desired green percentages are thinned according to the desired density.

The sampling was conducted during the growing season from two intermediate rows of each plot (34, 54, 68, 82, 96 and 110 days after corn emergence). For this, 5 meters of the length of the two intermediate rows of each plot (including a half-meter marginal effect) was allocated to this. Only 2 plants were harvested at each sampling time. After measuring plant height, the plant components were separated into leaves and stems. The leaf area of each sample was determined using a leaf area measurement device (LI-COR LI-3000. LI-COR Inc., Lincoln, NE). To determine the dry weight, the plant material was dried individually, first in an oven (at 80 ° C for 72 hours) and then the weight of each part was measured.

Classical growth models, such as logistic models, have been used extensively and repeatedly to describe various biological processes. Many of these models are the sigmoid curves that most biologists use (Colins & Berch, 1999). To illustrate the trend of measured changes in height, leaf area index and dry matter changes, the following logistic equation was used [10]:

$$Y=C\,[1+\exp(a-bx)]$$

In this equation, Y is the height or cumulative dry matter. The coefficients a and b, C, the maximum curve limit in each case and the ratio a / b, represent the time that the variable reaches its maximum half, x is the number of days after the corn is green.

3. RESULTS AND DISCUSSION

3.1 Height

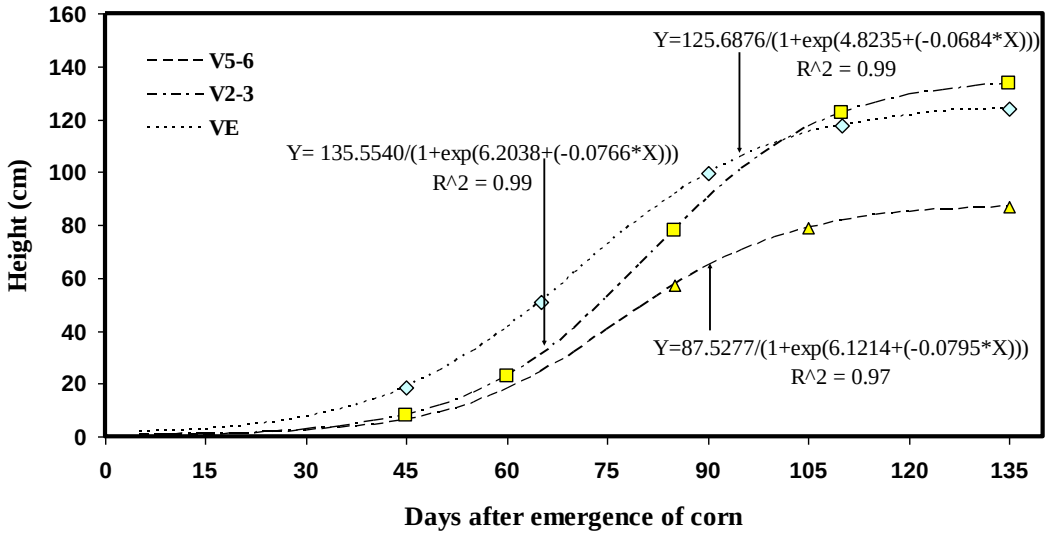
The effect of density on the height of lambsquarters is shown in Table 1 by the parameters of the equation. The maximum height in the lambsquarters that is in competition with corn is almost identical to the lambsquarters in monoculture, although there is not much difference between the three densities mentioned. As already mentioned, the ratio a / b shows the number of days to reach the half of the maximum height shown in the table1. There is no significant difference in monoculture condition, and in a competitive situation, the difference is not so significant. So that the densities of 6.6, 13.3 and 20 were 75, 78 and 76, respectively, from the planting to half their maximum height, while the maximum height of low density treatment with a high density is almost the same. These results indicate that the competition between corn and

lambsquarters in the same time treatment of emergence is more severe than other treatments. However, in emergence in 2-3 leaf stage, with increasing of height and emergence in the 5-6 leaf stage with a significant decrease in the height of the lambsquarters.

Table 1. Effect of density on the changes in height, leaf area and final dry matter of lambsquarters in competition with corn and mono culture.

	In competition						monoculture					
	Density	C	a	b	a/b	R2	Density	C	a	b	a/b	R2
Height	6.6	114.37	5.09	0.067	75.14	0.99	6.6	116.77	6.97	0.098	71.05	0.98
	13.3	117.49	6.13	0.078	78.09	0.98	13.3	117.33	6.98	0.096	72.25	0.98
	20	118.85	5.27	0.069	76.23	0.98	20	118.99	6.64	0.093	71.14	0.99
Leaf area	6.6	434.34	12.30	0.166	73.71	0.94	6.6	898.17	12.48	0.195	63.71	0.90
	13.3	304.03	13.63	0.187	72.89	0.95	13.3	934.58	10.49	0.160	65.23	0.98
	20	242.94	9.62	0.137	70.13	0.96	20	864.55	12.14	0.191	63.40	0.91
Total dry matter	6.6	106.27	14.97	0.275	54.46	0.97	6.6	448.73	8.27	0.116	71.07	0.99
	13.3	156.15	14.27	0.266	53.66	0.93	13.3	840.11	9.18	0.126	72.57	0.99
	20	231.54	14.34	0.263	54.56	0.97	20	1231.8	9.52	0.135	70.57	0.99

Figure. 1.

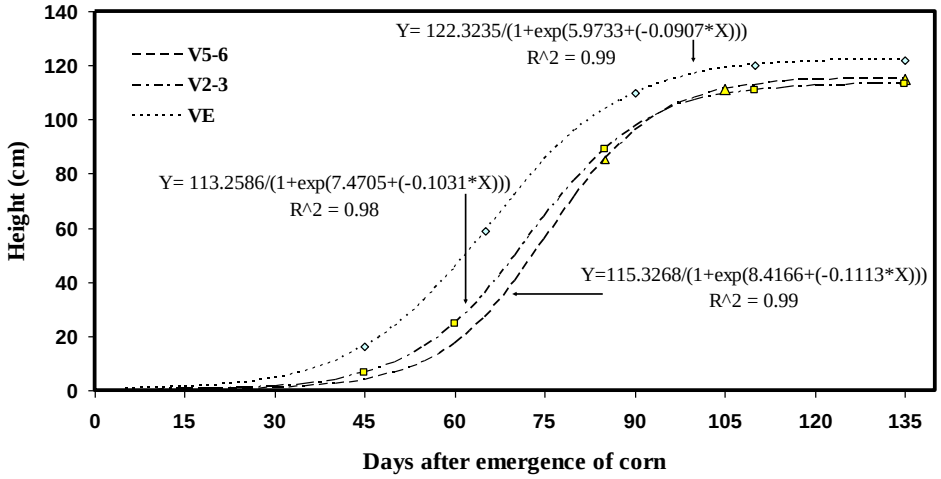


Differential curve of lambsquarters height in competition with corn in three relative time of emergence.

In fact, the delay in the emergence of lambsquarters caused the decrease due to the corn-induced competitive pressure, but in the 2-3 leaf stage, the lambsquarters is trying to reach the light source with increasing height. That's why the height has risen. As for the time of emergence, as in Fig. 1, in the competition state, the second emergence time (2-3 leaves of corn) has a maximum height of 135 cm and then the first and third time of emergence, have got the next rank. By comparing the a / b ratio, this value is 2-3 leaves and then 5-6 leaves. At the same time of emergence, is the lowest time to reach half its maximum height, which is a digit of about 70 days, while emergence in 5-6 leaves and 2-3 leaves is 10 and 6 days, respectively.

In monoculture conditions, it is observed that in same time emergence, with 122 centimeters heights, the highest amount was obtained, and with the delay of the emergence time, the crop height decreased (fig 2). As it is seen, in the treatment

of same time of emergence, it takes 65 days for the plant to reach half its maximum height, and for 72 and 75 days, it is necessary to reach the maximum height of 2 to 3 leaves and 5 to 6 leaves. In competitive mode, densities created at 2-3 leaf stage, have the highest height (Table 1). In the treatment of same time emergence, at the very early stages, from day 54 to 82, they increased their height at a very high speed, and the lambsuarters that grew in 2-3 and 5-6 leaf stage of corn at a time of about 68 to 96 days after planting corn, they have the highest rate of increase. In the treatment of same time emergence, at the very early stages, from day 54 to 82, they increased their height at a very high speed, and the lambsuarters that grew in 2-3 and 5-6 leaf stage of corn at a time of about 68 to 96 days after planting corn, they have the highest rate of increase. In general, by comparing two condition in terms of height, it can be said that there is no significant difference between the two monoculture modes and competition with maize treatment. Rohrig and Stotzel [9]investigated the effect of bean mix on lambsquarters that when the bean was slightly earlier than lambsquarters, it prevented the increasing of height in lambsquarters and caused it to be due to lack of radiation and consequently to the reduction of the production of photosynthetic material in the perennial plant, and also In some sources, it has been suggested in some cases that in order to get rid of under conditions of light scarcity, he wants to get enough light by increasing his height.



Figur.2. Differential **curve of lambsquarters height in mono culture in three relative time of emergence.**

3.2 Leaf area

As it is seen, in the effect of plant density on leaf area, the average density (13.3 plant/m2) has the highest leaf area per plant in monoculture conditions (Table 1). If you look at the process of increasing the leaf area, a low to moderate density increases the maximum leaf area. But at a density of 20 plants, the leaf area of a single plant is almost less than the low density. In fact, this result can be influenced by the density that neighbor plants have caused intra-species competition and have led to this decline. Also, there is no difference between half-times the maximum leaf area at the same time of emergence and emergence in 5-6 leaves (fig 3, 4), and the emergence in 5-6 leaves requires more time to reach the leaf area by half of its maximum value, that is, about 934 centimeters (Table 1). In the competition, the conditions seem to be slightly different and with increasing density the maximum leaf area will be reduced accordingly. So that the maximum leaf area at a low density is about 200 centimeters higher than the high density. Not only do we increase the density of the lambsquarters, but also the inter-species competition, and each plant has less space and resources, and probably the leaf area also decreases. In fact, this decrease in leaf area was equal to the increase in corn leaf area and had a negative correlation with corn leaf area. Kropff and Spitters,[11]observed that the competitive power of a species is determined by rapid growth in the early stages of the growing season and by utilizing the leaf area at the moment when the plant canopy is closed.

The time of emergence of weed is part of the ability of the plant to compete, because before the ripe plant begins its exponential growth stage, the weed has captured a lot of resources [12]. It is very clear that the difference in plant size is effective in competition, and a plant that has a larger size has more ability to absorb resources than smaller plants [12]. Therefore, the leaf area and stem mass can be considered as part of the power of any species in the competition to

attract resources in the vegetative communities. Since photosynthesis is the major determinant of biomass and plays a major role in competition between crops and weeds [12].

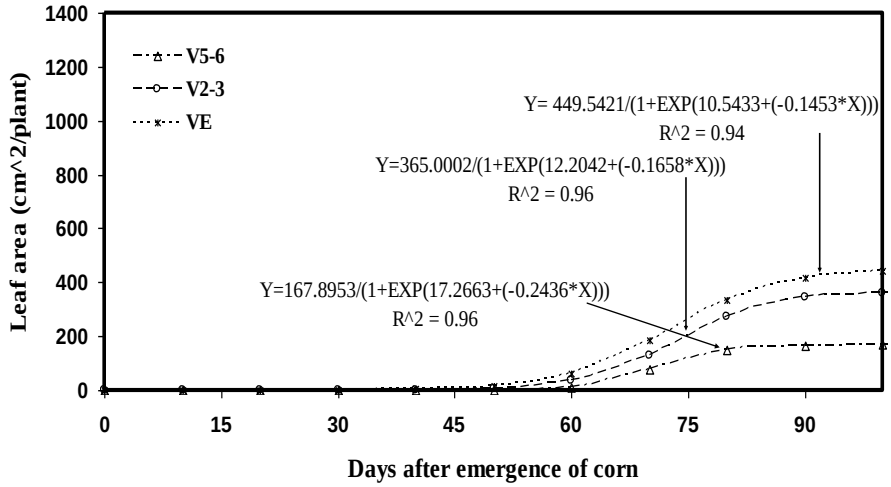


Figure .3. Differential curve of lambsquarters leaf area in competition with corn in three relative time of emergence.

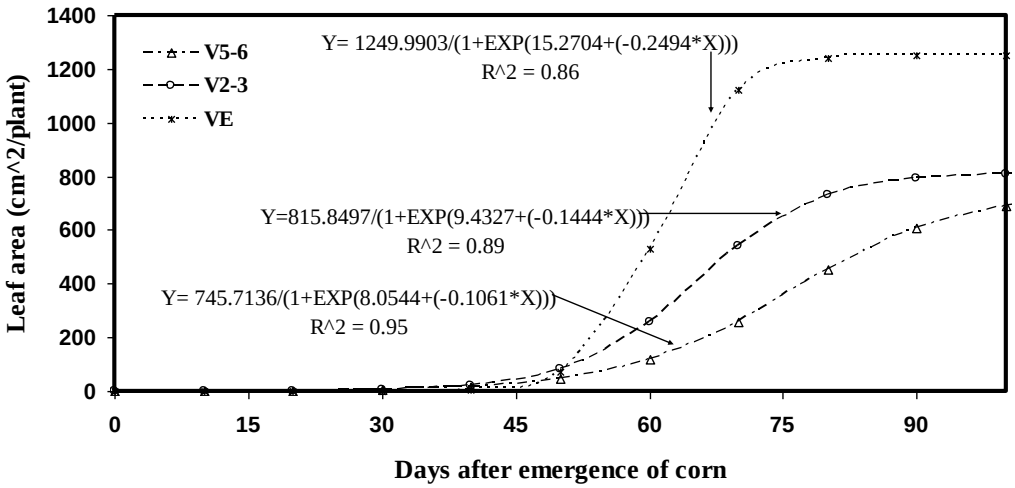


Figure .4. Differential curve of lambsquarters leaf area in mono culture in three relative time of emergence.

3.3 Accumulation of dry matter

Plant biomass production is strongly influenced by plant density, space, and competition intensity from crop and genotype. In table 1, it can be seen that in the conditions of competition, the maximum dry weight is related to high density and from the lowest density to the next density, we see an increase of 50% of the maximum biomass. Also, under competitive conditions, with increasing density to 13.3, we see an increase of 100% of maximum dry matter and increasing the density at 20 plants, the maximum dry matter increased by 50%. Comparison of the three densities mentioned in the competition with the same densities in monoculture shows that the maximum dry matter was reduced by 77, 81 and 81 percent in densities of 6.6, 13.3 and 20, which can be concluded that the competition between the lambsquarters and corn have increased.

Maximum accumulation of dry matter in the competition compared to monoculture decreased at same time emergence, emergence in 2-3 leaves and 5-6 leaves, 78, 81 and 82 percent, respectively (fig 5). The highest reduction was observed in the corn leaf stage of 5-6 leaves. In terms of competition, the number of days reaching half the maximum dry weight was similar in the same time of emergence treatments and 5-6 leaves (69 days), but in 2-3 leaves reached 72 days (fig 5). That means more days are needed to reach half the maximum dry weight. In monoculture conditions, with the delay of the emergence time, the number of days reaching to half the maximum dry weight increased, and from 69 in the same time emergence tireatment, reached 71 and 74 days in 2-3 leaves and 5-6 leaves.

The difference between treatments is due to the fact that there is no limiting factor in monoculture and the plant can continue to grow. But in competition conditions, because of the plant with an important limiting factor such as the canopy of the ripe (corn), there is not much difference. It is also found in 2-3 leaves of this time, which could be due to the equal competition between the two plants (fig 6).

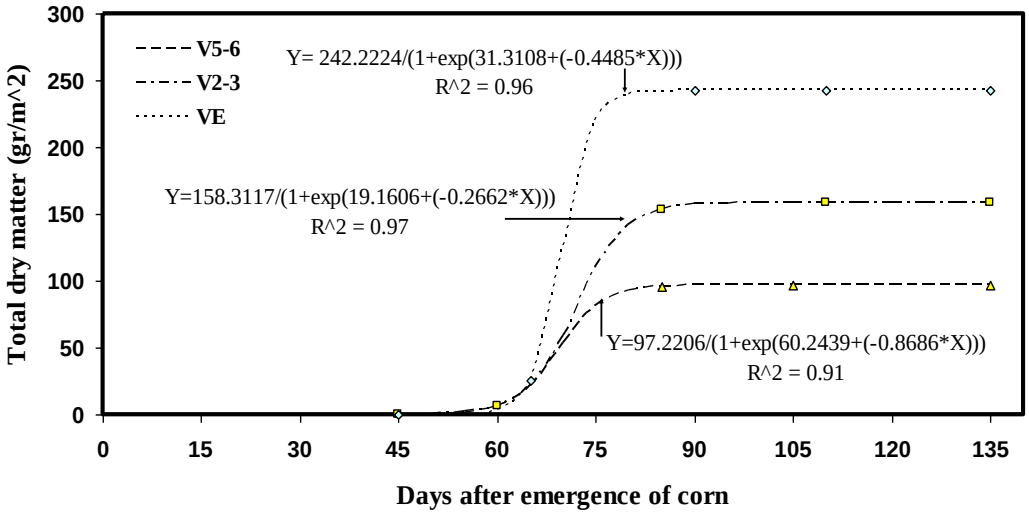


Figure .5. Defferential curve of lambsquarters total dry matter in competition with corn in three relative time of emergence.

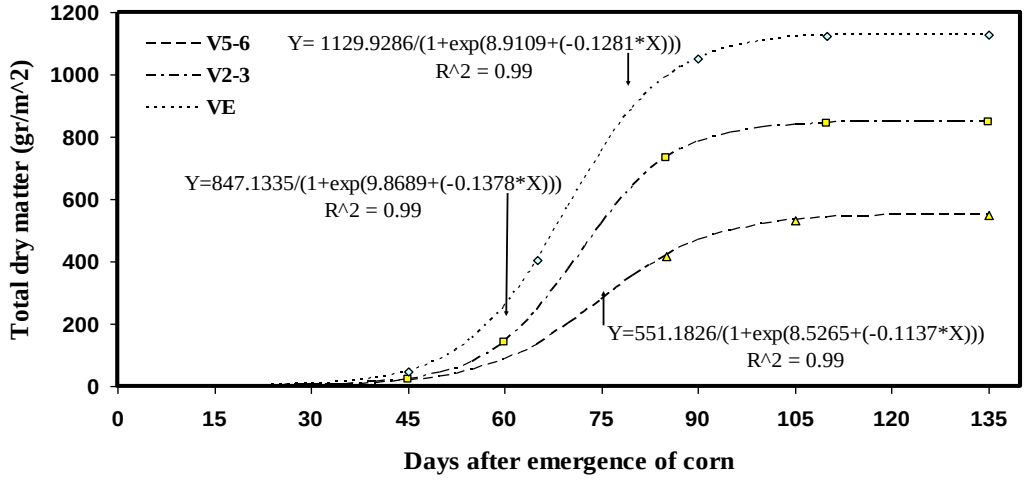


Figure .6. Differential curve of lambsquarters total dry matter in mono culture with corn in three relative time of emergence.

4. CONCLUSION

The interesting point is that, in competition with maize, two differences are observed with monoculture. First, lambsuarters in the 5-6 leaf stage is emerged, have the lowest height and, in the monoculture mode, the treatments that are emerged at the same time, in the final stages of sampling have the highest height. However, the treatments are not significantly different in terms of the velocity of height increase, since day 68 is the same as 54 days after planting of V2-3 treatment, and also 40 days after planting of V5-6 treatment, and with the delayed emergence time, the highest rate of increase Height is delayed. Concerning the effect of density on the leaf surface, it can be said that in monoculture mode, the density affects the leaf area under the influence of different germination times. These results can be related to this issue: delayed on emergence and due to the fact that the heat and heat increase, the salmon will reduce the leaf area, since under low temperature conditions it is compared with heat higher competitive power is much higher.There may be little evidence that there is a relationship between leaf photosynthesis and plant growth, but in contrast to biomass production, it is directly related to the absorption of light, which is mainly determined by the surface of the leaf. In the study of the effect of plant density on leaf area, the average density was the highest leaf area per plant in monoculture conditions. From a low to medium crop, the increase in the maximum leaf area was observed.

REFERENCES

References must be listed at the end of the manuscript and numbered in the order that they appear in the text. Every reference referred in the text must also present in the reference list and vice versa. In the text, citations should be indicated by the reference number in brackets [3].

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