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CORRELATIVE DEPENDENCIES BETWEEN THE DENSITY AND GROWTH PARAMETERS OF *SINAPIS ARVENSIS* (L)

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Abstract

Pot trials were performed in a glasshouse of Institute, during 2011 and 2012. The experiment included five variants with different density of *Sinapis arvensis* L. (1, 3, 6 and 9 plants per plot) with four replicates. The weed height, fresh weight, dry weight and leaf area were determined on 5^{th}, 15^{th}, 25^{th}, 35^{th} days after seed germination. The dependence between the number of *Sinapis arvensis* and growth parameters his is summarized by the coefficient of correlation (r^2).

It was established that the main parameters determining intraspecific competitive relations in the weed are height, fresh weight, dry weight, leaf area. The growth parameters of *Sinapis arvensis* progressively decreased as the number of weed from 3 to 9 per pot increased. Results of investigation showed that between density of the weed and growth and development his correlative negative dependencies was found. The coefficients of correlation (r^2) were very high during the period of studies 5-35 days after germination in all parameters. Marked negative correlations are significant. Height, fresh weight, dry weight, leaf area of weed plants significantly decreased with increasing density of *Sinapis arvensis*. The density of this weeds is one the factors which govern its growth, development and seed production.

Intraspecific competitive relation and correlative negative dependencies between the density of *Sinapis arvensis* and its growth parameters could be useful for examining the biological control of weeds and prediction of yield loss in crop.

Key words: Sinapis arvensis, density, growth parameters, coefficient of correlation

Introduction

Competition between weeds depends on their densities. Intraspecific competitive relations between weeds are a base in the studies of crop/ weed competition.

Increase in the weed number will affect the growth and wield of weed itself through intraspecific effect (de Wit, 2000). *Echinochloa grus-galli, Poa annua, Setaria viridis, Chenopodium album* fresh weight per plant and leaf area were decreased as the density of weed was increased. The dry weight of the weed per plant was reduced as density was higher at higher nutrient levels. More of the dry matter of *Chenopodium album* was allocated to seed when grown at high density (Spiters and van den Bergh, 2002; Williams, 2002). The height, weight of above- ground parts and roots of *Chenopodium album* significantly decreased with increasing density up to six plant per pot. Competition between roots is more important than above-ground competition in *Chenopodium album* (Sattore and Snaydon, 1992). The main parameters determining intraspecific competitive relations in the weeds *Papaver rhoeas, Avena fatua* and *Setaria viridis* are: height, fresh weight, dry weight, leaf area per plant. In the period from 10^{th} to 40 th day after seed germination between the numbers of weeds (2, 4, 6, 8 at an area of 250cm^2) and growth parameters a negative correlations was established (Nakova, 2003[a], Nakova 2003[b], Nakova, 2004). Competition in annual weeds (*Senecio vulgaris, Amaranthus retroflexus, Chenopodium album*) significantly increased with increasing the density of weeds up to five per pot. The levels of height, fresh weight, leaf area per plant decreased with competition 4 weeks after germination (O' Donovanl et al., 1995). Campbeli

(1998) found negative correlative dependencies between the numbers of weeds (*Chenopodium album, Amaranthus retroflexus, Sinapis arvensis, Xanthium strumarium)* and their growth parameters. An increase density of weeds 6-14 per pot decreased their levels of the height, above-ground weight, leaf area in early competition 10-20 days after germination. Negative correlation between number of weeds *Viola arvensis, Papaver rhoeas* and their growth parameters it was established (Gerovit and Heitefuss, 1996). Weed competition influenced the seed production. It depends on the weed density. The *Amaranthus retroflexus* density of 16 -20 plants m^2 increased the soil seed bank by 14 000- 20 000 seeds m^2, respectively (van Heemst, 1995; Zimdahl, 1999).

The purpose of the present study was to establish intraspecific competition in *Sinapis arvensis* and correlative dependencies between the density and growth parameters of the weed.

Materials and methods

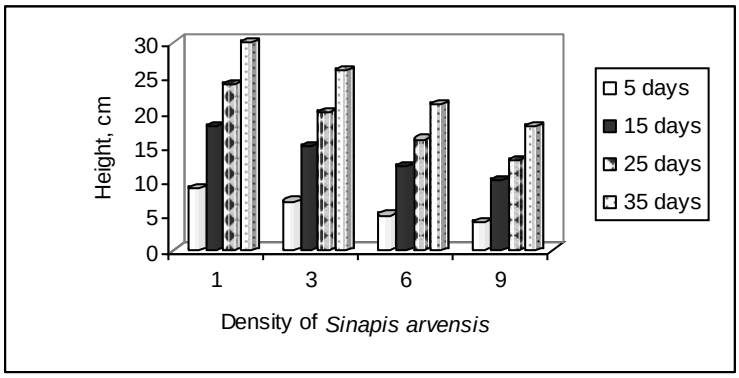
The pot trails were performed in a glasshouse of the Institute in 2011 and 2012. The soil was a sandy clay loam containing 73, 3% sand, 19, 5% clay, 1,07% organic mater and with pH 6,4. The seeds of *Sinapis arvensis* were collected in 2010 and 2011 in the region of Kostinbrod. Their germination was more than 85% in the both years.

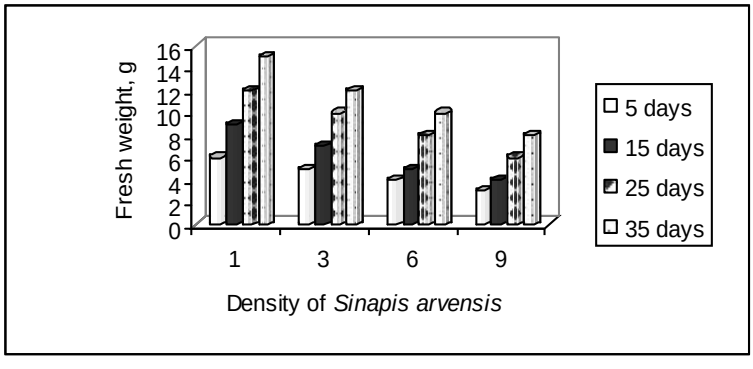
Pots of 25 cm diameter and depth of 20 cm, with an area of 500 cm^3 were filled with air dried soil. After germination of *Sinapis arvensis* seedling were thinned to 1, 3, 6, 9 seedlings per plot. The variants were replicated four times. Late emerging *Sinapis arvensis* plants and other weeds were removed by hand. The plants were watered daily. The glasshouse average temperature was 18-22^o C. The duration of the trails in 2011 and 2012 was 35 days after seed germination. The *Sinapis arvensis* height(cm), fresh weight(g), leaf area(cm^2) per plant for each variants were determined on 5th, 15th, 25th, 35th days after germination. The growth parameters – leaf area was measured by LICORLI 3100, leaf area meter.

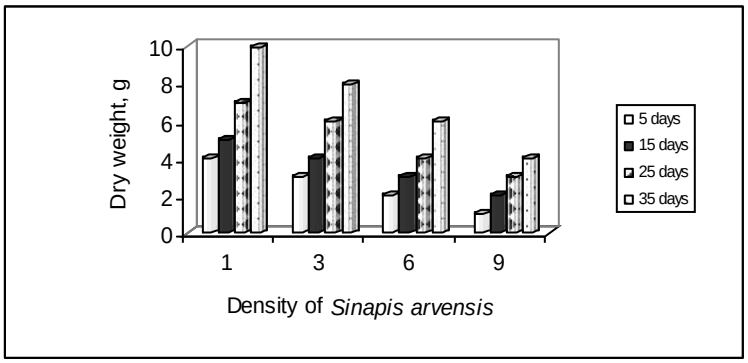
Correlation analyses are employed by statistically processing the data (SAS, Version 5,0).Correlative dependencies between the density and growth parameters of *Sinapis arvensis* are summarized by the coefficient of correlation (r^2).The graphs and correlative dependencies are based on the average data over the period 2011- 2012, since data appear uniform over the period.

Results and discussion

The growth parameters per plant of *Sinapis arvensis* in the period from the 5th to 35th days after seed germination were significantly reduced as the density of the weed was increase (Figure 1).







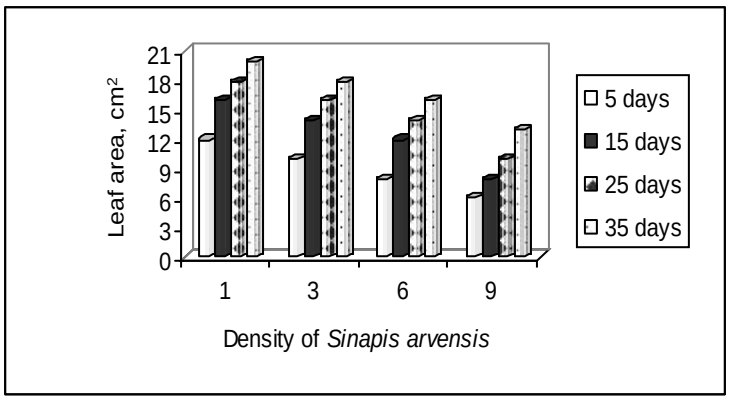


Figure.1 The effect of density on growth parameters of *Sinapis arvensis*

The biggest height, fresh weight, dry weight and leaf area per plant were in pots with one *Sinapis arvensis* plant. The increasing weed density affected negatively on its growth on the 5th day after germination. At 3 plants per pots height, fresh weight, dry weight and leaf area of the weed were 78%, 83%, 75%, 83%, respectively, compared with the control (one *Sinapis arvensis* plant per pot). The reduction of these parameters was unidirect in the period 5- 35 days after germination. A greatest effect was found at densities of 6 and 9 plants per pot. Negative effect in the other parameters was established. The presence of 9 plants per pot for the period 5-35 days lowered leaf area by 35- 50% as compared with the control.

Correlative negative dependencies between the density and growth parameters of *Sinapis arvensis* during the studied period were established (Tables 1, 2, 3 and 4). Marked correlation are significant at $P< 0.05$. The coefficient of correlation (r^2) between number of weeds per pot and height, fresh weight, dry weight, and leaf area per plant varied from -0,94 to -0,98(table 1), from -0,96 to -0,98 (table 2), from -0,97 to -0,99 (table3), from -0,97 to -1 (table 4).

Table1.Correlative dependencies between density and growth parameters of *Sinapis arvensis* on 5th day after germination. Marked correlation are significant at P< 0.05.

Variables	Weed number	Height	Fresh weight	Dry weight	Leaf area
Weed number	1.0	-0.98*	-0.98*	-0.98*	-0.94*
Height	-0.98*	1.0	0.96*	0.95*	0.98*
Fresh weight	-0.98*	0.96	1.0	0.96*	0.96*
Dry weight	-0.98	0.95*	0.96*	1.0	0.94*
Leaf area	-0.94*	0.98*	0.96*	0.94*	1.0

Table 2. Correlative dependencies between density and growth parameters of *Sinapis arvensis* on 15th day after germination. Marked correlation are significant at P< 0.05.

Variables	Weed number	Height	Fresh weight	Dry weight	Leaf area
Weed number	1.0	-1.0*	-0.98*	-0.98*	-0.96*
Height	-1.0*	1.0	0.98*	0.98*	0.96*
Fresh weight	-0.98*	0.98*	1.0	0.98*	0.96*
Dry weight	-0.98*	0.98*	0.98*	1.0	0.96*
Leaf area	-0.96*	0.96*	0.96*	0.96*	1.0

Table 3. Correlative dependencies between density and growth parameters of *Sinapis arvensis* on 25th day after germination. Marked correlation are significant at P< 0.05.

Variables	Weed number	Height	Fresh weight	Dry weight	Leaf area
Weed number	1.0	-0.99*	-0.99*	-0.98*	-0.97*
Height	-0.99*	1.0	0.97*	0.99*	0.96*
Fresh weight	-0.99*	0.97*	1.0	0.97*	0.98*
Dry weight	-0.98*	0.99*	0.97*	1.0	0.95*
Leaf area	-0.97*	0.96*	0.98*	0.95*	1.0

Table 4. Correlative dependencies between density and growth parameters of *Sinapis arvensis* on 35th day after germination. Marked correlation are significant at P< 0.05.

Variables	Weed number	Height	Fresh weight	Dry weight	Leaf area
Weed number	1.0	-1.0*	-0.98*	-0.97*	-1.0*
Height	-1.0*	1.0	0.96*	0.97*	0.96*
Fresh weight	-0.98*	0.96*	1.0	0.97*	0.98*
Dry weight	-0.97*	0.97*	0.97*	1.0	0.95*
Leaf area	-1.0*	0.96*	0.98*	0.95*	1.0

The result of the experiment showed that the strong competitive effect of *Sinapis arvensis* could be related to weed density. Height, fresh weight, dry weight, leaf area of weed plants significantly decreased with increasing density. A small number of weeds 3 plants per pot had effect on the growth parameters. At density of 6 plants, weed had almost similar effect, but at higher densities 9 plants per pot had higher effect. Similar results on *Xanthium strumarium* were obtained by Kappoor and Ramakrishnan (1998) who showed that various parameters of weed growth

decreased with increase in density. The development and seed production of the weed responded to density stress.

Result indicated that growth parameters of *Sinapis arvensis* progressively decreased as the number of weed plants increased. Height, fresh weight, dry weight, leaf area per plant were reduced as function of weed density.

The work shows that weed density is a major factor in governing weed biomass. Weed biomass production was strongly influenced by density in both years. The weed density governing above-ground biomass and leaf area is important as they will also affect the quantities of weed biomass production.

Between the density of *Sinapis arvensis* and studied parameters negative correlative dependencies in the period 5-35 days after seed germination was established. Increasing the number of weeds per plot decreased the level of height, fresh weight, dry weight, leaf area per plant. The correlation coefficients (r^2) for each growth parameters were very high. They confirm the hypothesis of the study of the presence of intraspecific competition between density and growth and development of *Sinapis arvensis*. The correlation coefficients between weed parameters and the number of weeds relatively increased in order: leaf area>dry weight>fresh weight> height. Marked correlations are significant at $P< 0,05$. At 95% of weed plants it was established the effect of the density on their reductions of height, fresh weight, dry weight, leaf area in the period of 5-35 days after seed germination.

The work reported that the threshold based on weed density tends to be reliable for general use. This study contributes to a better understanding of the density of weeds as a factor which govern weed growth, development and seed production.

Intraspecific competitive relations and correlative dependencies in *Sinapis arvensis* are a threshold based in the studies of crop/ weed competition.

Conclusion

Intraspecific competation of *Sinapis arvensis* in the characteristics – height, fresh weight, dry weight, leaf area during the period 5^{th}-35^{th} days after germination it was established. The growth parameters per plant of *Sinapis arvensis* decreased as weed density (from 3, 6 to 9 per pot with area 500 cm^3) increased. Negative correlative dependencies between density of *Sinapis arvensis* and growth parameters on 5^{th}, 15^{th}, 25^{th} and 35^{th} days after germination was found.

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