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IMPACT OF THE SYSTEM OF CULTIVATION ON THE VEGETATIVE GROWTH AND REPRODUCTIVE DEVELOPMENT OF OATS

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Abstract

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In the period 2005-2007 were carried out trials with five oats populations (Krivogastani, Trebenista, Radolista, Bugarija and Kuceviste) and three oats varieties (Rajac, Slavuj and Lovkjen), which were set in terms of organic and conventional production. The time and duration of individual stages in oats growth depends on a number of factors, among which should be mentioned: the variety, soil fertility, climatic conditions and agro techniques. Our main objective was to determine the differences in time of occurrence of certain stages because of the system of cultivation, ie, conventional farming systems or organic farming system. During vegetation, the changes in the development of reproductive organs of class are monitored. Taking into account the fact that the plants in organic farming system, in all years of the examination, in the initial stages had faster vegetative growth, in tasseling stage organic production came to the fore, especially in 2006, when all populations and species tasseled 4-5 days earlier. The method of cultivation, its influence highlighted by shortening the organogenetic development of organic production for 2-3 days in the first, second and third year of examination.

Key words: oat, vegetative growth, reproductive development, organic, conventional

Introduction

Oats (*Avena sativa* L.), is grown mostly for grain. Because of its biological value, it is used in the diet of man and animals. Today, oats are among the many important crops in the human diet, with increased demand in modern cooking and food technology.

Peeled oat grain is easily digestible, and in human nutrition comes through a large number of industrial products: oat flour, diet bread, oat flakes, meal, muffins, etc.

Today, in the production of oats, different systems of cultivation are applied and the quality in oats of these breeding systems is different.

According to Georgieva et al. (2005) examining the morphological and biological properties of the seven lines oats in two agro-ecological regions in Republic of Bulgaria (Plovdiv Karnobat), it was found that all tested lines are characterized by greater stability depending on the growing conditions that prevail in the regions, and medium to strong variability under the influence of environmental conditions in certain areas.

The time and duration of individual stages in oats growth depends on a number of factors, among which should be mentioned: the variety, soil fertility, climatic conditions and agro technics.

Our investigations relating to the impact of farming systems on vegetative growth and reproductive development of oats in a great number of domestic and foreign populations and varieties of oats.

Material and Methods

The tests were conducted in field and laboratory conditions. The field trials were set on the experienced field of Faculty of Agriculture, University Goce Delchev "- Stip, Strumica, and laboratory tests were conducted in the laboratories of the Faculty of Agriculture in the period from 2005 to 2007.

Five oats populations were analyzed, from which four were local populations (Krivogastani Trebenista, Radolista and Kuceviste) and one was introduced from Bulgaria (popu-

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lation Bugarija) and three oats varieties introduced from Serbia (Rajac, Slavuj and Lovkjen).

Two experiments were set, in which were present all the above-mentioned genotypes oats, except that in one experiment all variants were set in terms of conventional production, and the other in terms of organic production.

The experiments consisted of eight variants in four repetitions, deployed by the method of random block system, with dimension of basic plot of 5 m^2. The distance between the variants was 0,50 m, and between repetitions – 1.0 m. The distance between rows was 20 cm. Used seed rate was 550 grains per $1m^2$, ie 5.5 million grains per 1ha. In all our years of examination pre culture was potatoes. Sowing in all the years of examination was performed during the month of March, more precisely: 17.03.2005, 28.03.2006 and 06.03.2007, ie when there were optimal conditions. Sowing is performed manually, in rows, at a depth of 5-6 cm.

During vegetation the most important growing stages were monitored: emergence, tillering, booting, tasseling and maturity. During vegetation the changes in the development of reproductive organs in the tassel were monitored.

Vegetative growth and reproductive development of plants are monitored and assessed by the method of Cooperman (1955).

Climate Conditions

During the three-year trials meteorological indicators about medium monthly air temperatures in degrees Celsius and monthly precipitation amounts in millimeters were monitored.

The average annual temperature in Strumica valley (Table 1), for a period of ten years 1994/2004 is 13.2°C. For a period of ten years 1994/2004 in Strumica valley in average fall 614.2 mm rain (Table 2). Distribution of precipitation (Table 2) after months and seasons is quite unbalanced. The most rainy is December with an average amount of 81.9 mm. The most arid month, with the lowest average amount of rainfall, is February with 33.7 mm.

The analysis of the temperature in the test period 2005-2007 (Table 1), showed high similarity with high annual temperatures in the ten-year average. The average annual temperature in 2005 was 0.3°C lower than the multi-annual average, in 2006 was 0.4°C lower, and in 2007 was 0.9°C higher than the average.

According to the data in Table 1 it can be concluded that the average air temperatures during vegetation oats in the three years of testing are the lowest in the first month of the vegetation, ie in March (from 7.8 to 9.8°C) and highestin July (23.7-27.6°C). These medium monthly temperatures that prevailed in the three years of testing, are considered as good for growing oats. For successful vegetation oats requires a lot of water and are therefore is considered as a cereal that has the greatest need of it.

According to Vasilevski (2004) and Egumenovski et al. (1998) critical periods for water are the stages of formation of the generative organs (about 15 days before tasseling) and time of intensive growth (until tasseling).

In Table 2 it can be seen that in 2007, during vegetation period of oats, in the month of April, the largest deficit of precipitation is marked (only 2.2 mm). Otherwise, in other months and years, the distribution of rainfall is relatively good and suit the needs of oats.

Results and Discussion

Vegetative growth

Vegetative growth of oats goes through more stages, in which, the formation and growth of certain vegetative parts

Table 1
Average monthly temperatures in degrres Celsius

Year	Month												Annual sum of temperatures	Average annual temperatures
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
2005	2.5	-0.1	7.8	12.9	18.7	21.9	25.0	23.8	19.4	13.2	5.4	4.2	4708.5	12.9
2006	-0.3	2.0	8.2	13.5	18.1	21.4	23.7	24.1	19.5	14.3	6.7	2.8	4672.0	12.8
2007	5.0	5.9	9.8	13.7	19.8	24.1	27.6	24.6	17.7	13.3	5.9	1.9	5146.5	14.1
1994/2004	1.1	4.0	7.8	12.3	18.4	22.6	25.0	24.0	18.7	13.2	7.3	2.7	4831.2	13.2

Table 2
Amount of monthly rainfall in mm

Year	Month												Annual amount of precipitation
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
2005	48.9	96.4	43.5	36.7	50.0	12.9	35.5	75.9	63.9	58.0	34.2	52.1	608.0
2006	58.7	56.4	75.0	31.8	34.0	107	26.7	19.9	63.9	85.6	39.7	34.3	632.9
2007	16.5	24.0	39.7	2.2	107.5	45.6	0.3	73.9	41.0	127	74.8	41.4	593.7
1994/2004	48.0	33.7	36.4	48.9	51.5	49.3	57.8	34.9	53.8	57.7	60.3	81.9	614.2

of the plant occur. Each of these stages is characterized by its own characteristics and is tied to the existence of certain conditions that only in the optimal ratio enable their uninterrupted functioning.

Vegetative growth takes place in parallel with the stage yarovisation and organogenetic development. The time and length of the progress of individual stages in oats depends on a number of factors, among which should be mentioned: the variety, soil fertility, climatic conditions and agro techniques. In our trials, the following stages were registered: emergence, tillering, booting, tasseling and maturity.

The results are shown in Tables 3, 4 and 5, for organic production and in Tables 6, 7 and 8 for conventional production.

After the emergence of the seed over the soil surface, and the appearance of the first true green leaf, at a height of 2-3 cm, the stage emergence is marked. The time of occurrence

Table 3
Phenological observations in the organic production of oats in 2005 year

Variety / Population	Stages						
	sowing	emergence	tillering	booting	tasseling	milk maturity	ripening
Krivogastani	18.03	29.03	12.04	06.05	31.05	26.06	07.07
Trebenista	18.03	29.03	13.04	06.05	31.05	26.06	06.07
Radolista	18.03	29.03	13.04	07.05	31.05	26.06	07.07
Bugarija	18.03	29.03	13.04	05.05	30.05	26.06	06.07
Kuceviste	18.03	29.03	13.04	06.05	01.06	26.06	07.07
Rajac	18.03	29.03	13.04	06.05	02.06	27.06	08.07
Slavuj	18.03	29.03	13.04	06.05	01.06	27.06	08.07
Lovkjen	18.03	29.03	13.04	06.05	01.06	27.06	07.07

Table 4
Phenological observations in the organic production of oats in 2006 year

Variety / Population	Stages						
	sowing	emergence	tillering	booting	tasseling	milk maturity	ripening
Krivogastani	28.03	07.04	19.04	14.05	06.06	26.06	10.07
Trebenista	28.03	07.04	19.04	14.05	06.06	25.06	10.07
Radolista	28.03	07.04	19.04	14.05	06.06	26.06	10.07
Bugarija	28.03	07.04	19.04	14.05	06.06	25.06	10.07
Kuceviste	28.03	07.04	20.04	15.05	07.06	26.06	10.07
Rajac	28.03	07.04	19.04	15.05	07.06	27.06	11.07
Slavuj	28.03	07.04	19.04	15.05	07.06	27.06	11.07
Lovkjen	28.03	07.04	19.04	14.05	06.06	27.06	10.07

Table 5
Phenological observations in the organic production of oats in 2007 year

Variety / Population	Stages						
	sowing	emergence	tillering	booting	tasseling	milk maturity	ripening
Krivogastani	06.03	20.03	10.04	05.06	23.05	15.06	28.06
Trebenista	06.03	20.03	10.04	06.06	23.05	15.06	28.06
Radolista	06.03	20.03	10.04	06.06	23.05	15.06	28.06
Bugarija	06.03	20.03	10.04	06.06	24.05	16.06	30.06
Kuceviste	06.03	20.03	10.04	06.06	24.05	16.06	30.06
Rajac	06.03	20.03	10.04	06.06	25.05	17.06	30.06
Slavuj	06.03	20.03	10.04	06.06	25.05	17.06	30.06
Lovkjen	06.03	20.03	10.04	06.06	25.05	17.06	30.06

of the seed over the soil is different and depends on several factors, among which as limiting can be considered the time and depth of sowing, temperature and humidity.

Generally, spring oats should be sown immediately after the soil dries enough to make it easy to work. Early sowing results with higher grain yields with higher quality, because of the following reasons: the plant has greater tassel; less diseases affecting the leaves occur; complete or partial avoidance of high temperatures and drought stresses that are commonly present in the period of filling the grain (Marshall et al., 1992).

In the first year of the experiment the sowing was performed 17.03 (Table 6) and 18. 03 (Table 3). In February fell 96.4 mm rain (Table 2), and that did not allow us sowing in the begining of March, but there were relatively good conditions for emergencing of oats. The period from sowing to emer-

Table 6
Phenological observations in the conventional production of oats in 2005 year

Variety / Population	Stages						
	sowing	emergence	tillering	booting	tasseling	milk maturity	ripening
Krivogastani	17.03	28.03	12.04	07.05	01.06	26.06	07.07
Trebenista	17.03	28.03	12.04	06.05	31.05	26.06	07.07
Radolista	17.03	28.03	12.04	07.05	01.06	27.06	08.07
Bugarija	17.03	28.03	11.04	05.05	31.05	26.06	07.07
Kuceviste	17.03	28.03	12.04	06.05	01.06	27.06	08.07
Rajac	17.03	28.03	12.04	06.05	01.06	27.06	08.07
Slavuj	17.03	28.03	12.04	06.05	01.06	28.06	08.07
Lovkjen	17.03	28.03	12.04	06.05	01.06	28.06	08.07

Table 7
Phenological observations in the conventional production of oats in 2006 year

Variety / Population	Stages						
	sowing	emergence	tillering	booting	tasseling	milk maturity	ripening
Krivogastani	28.03	07.04	20.04	14.05	11.06	01.07	11.07
Trebenista	28.03	07.04	21.04	14.05	11.06	30.06	11.07
Radolista	28.03	07.04	21.04	14.05	12.06	01.07	11.07
Bugarija	28.03	07.04	21.04	14.05	11.06	01.07	10.07
Kuceviste	28.03	07.04	22.04	15.05	11.06	01.07	10.07
Rajac	28.03	07.04	21.04	15.05	11.06	01.07	11.07
Slavuj	28.03	07.04	21.04	15.05	11.06	01.07	11.07
Lovkjen	28.03	07.04	21.04	14.05	11.06	01.07	11.07

Table 8
Phenological observations in the conventional production of oats in 2007 year

Variety / Population	Stages						
	sowing	emergence	tillering	booting	tasseling	milk maturity	ripening
Krivogastani	06.03	22.03	12.04	08.05	24.05	17.06	30.06
Trebenista	06.03	22.03	12.04	08.05	24.05	17.06	30.06
Radolista	06.03	22.03	12.04	09.05	24.05	17.06	30.06
Bugarija	06.03	22.03	11.04	07.05	25.05	17.06	30.06
Kuceviste	06.03	22.03	11.04	07.05	25.05	18.06	01.07
Rajac	06.03	22.03	11.04	07.05	26.05	18.06	01.07
Slavuj	06.03	22.03	11.04	08.05	26.05	18.06	01.07
Lovkjen	06.03	22.03	11.04	08.05	26.05	18.06	01.07

gencing of oats, in both trials was 11 days (Tables 3 and 6), at an average monthly temperature of 7.8°C.

Minimum temperature for emergencing of oats is 4-5°C, the optimum temperature is 25°C, and the maximum temperature is 30°C. In optimal conditions oats emerge in 6 to 8 days (Vasilevski, 2004).

Second year, at the time of sowing, was very rainy. In March we had 75.0 mm precipitations (Table 2), and we had to delay the sowing to 28.03 (Tables 4 and 7). But there were relatively good conditions for emergencing, and the period from sowing to emergencing was the shortest (only ten days). The seed of oats, after sowing, found very humid and warm soil and immediately started to water absorption and swelling. In such conditions begin accelerated physical, chemical and biological processes and fast emergencing of the seed over the soil surface.

The third year of the examinations was more arid in the time for initial development of oats. In this year we had an earlyest sowing (06.03). Arid conditions in February and March caused extension of the period from sowing to emergencing to 14 days in organic (Table 5) and 16 days in conventional production (Table 8). In the third year of the examinations in March (Table 1) were measured the highest temperature (9.8°C).

From the above, one can clearly conclude that the temperature and especially humidity plays a decisive role in the emergencing of oats. A characteristic example of this is the second year of the examinations, compared with two years remaining, when sowing was performed the latest and the emergencing was noted earliest.

During the three years of the examinations the tillering starts in different terms that depend on the date of emergencing of oats, which of course depended on the temperature and humidity in the years of investigation. So in 2005 initially tillering was observed on April 13 (after 15 days of emergencing) (Tables 3 and 6), in the second year on April 20 (after 13 days of emergencing) (Tables 4 and 7) and in the third year on April 10 (after 21 days of emergencing) (Tables 5 and 8). In the third year of the examinations, the period from emergencing to tillering was the longest, due to the small amount of precipitations in April (only 2.2 mm).

Booting represents the first phase in the generative development of oats. While in the begining of the tillering the nodes of the culm and the ear rudiments were formed, at this stage of development their growth and elongation beguns.

Parallel with the growth starts and formation of the tassel, the spikes, the flowers and organs of the flower. For high yields, at this stage of the development of oats, sufficient amounts of water and nutrients are necessary.

In our examinations this phase began simultaneously in all oats populations and varieties. Difference appeared in 2007, between organic and conventional production (Tables 5 and 8). In organic production this stage started 2-3 days earlier (Table 5).

The tasseling begins with the release of the tassel of the last leaf collar in which all constituents are fully formed.

External environmental conditions have a pronounced effect on the length of the tassel and its constituent parts. According to Georgieva (1995), date of sowing and sowing density did not affect on the length of the tassel, but climatic conditions by years had an impact on length of the tassel.

According to the meteorological conditions in the region of Strumica, in the years of examinations, the best conditions for development of the tassel of oats, in terms of temperature and humidity, there were in 2007. The total precipitations of 107.5 mm (Table 2) and a relatively high temperature in May, allowed normal development of the tassel and its constituent parts, which positively affected on the number of grains in the tassel in almost all populations and varieties, in both trials. The number of days from the booting stage to the tasseling stage, was shortest in 2007 (Tables 5 and 8). Organic production, in the stage tasseling, came to the fore, especially in 2006, when all populations and varieties tasseled 4-5 days earlier (Table 4).

With the completion of tasseling immediately begins blooming, and pollination is carried out at the same moment when the flowers open. Analyzing the temperature and precipitation during this period, and in the three years of examinations, can be concluded that there were optimal conditions for the successful conduct of this period of development of oats.

Immediately after fertilization, begins forming and pouring of the grain. The length of the period from fertilization to ripening, as well as the duration and success of the individual stages depend on the method of cultivation, but also from external conditions. In conditions where the experiment is performed, in the three years of examinations, the sub stage milky ripe conduct in a period of 10-15 days, which is in the range of similar trials in our country (Vasilevski, 1980). After assessing of the ripe for cutting approached to harvest.

It should be mentioned that on the time and length of the growing stages greatly influence the characteristics of the variety, but also greatly affect climatic conditions, especially temperature and humidity. Longest vegetation in both organic and conventional production we had in 2007, as a result of the precipitation that fell in May and June (total 153.1 mm).

Reproductive development (organogenesis)

Organogenesis (reproductive growth), ie formation of the generative organs of oats takes place gradually and in stages.

Knowing the stages of reproductive development, and in accordance with the fixed effect of individual factors on them, with separate agro technical measures, could affect on the proper targeting of the development of the fructify organs for maximum production.

According to Cooperman et al. (1955), reproductive development in oats takes place across 12 stages.

In Tables 9, 10, 11, 12, 13 and 14 the reproductive development oats by stages is given, in both systems of productions.

The first stage is characterized by undifferentiated growth cone and is a hemispherical bud. This stage takes place when the plant is in stages: emergence, the stage three leaves and in the beginning or various moments of tillering.

Table 9
Reproductive devolopment (organogenesis) in the organic production of oats in 2005 year

Variety / Population	Stages											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Krivogastani	30.03	13.04	18.04	05.05	13.05	20.05	27.05	30.05	06.06	19.06	25.06	07.07
Trebenista	30.03	13.04	20.04	06.05	14.05	20.05	27.05	31.05	07.06	19.06	25.06	06.07
Radolista	30.03	13.04	18.04	06.05	13.05	20.05	27.05	30.05	07.06	19.06	26.06	07.07
Bugarija	30.03	13.04	19.04	06.05	13.05	19.05	26.05	30.05	06.06	19.06	26.06	06.07
Kuceviste	30.03	13.04	19.04	06.05	14.05	20.05	27.05	30.05	06.06	19.06	26.06	07.07
Rajac	30.03	13.04	19.04	06.05	14.05	21.05	28.05	01.06	07.06	20.06	26.06	08.07
Slavuj	30.03	13.04	19.04	06.05	14.05	21.05	28.05	30.05	07.06	20.06	26.06	08.07
Lovkjen	30.03	13.04	19.04	06.05	14.05	21.05	28.05	01.06	07.06	20.06	26.06	07.07

Table 10
Reproductive devolopment (organogenesis) in the organic production of oats 2006 year

Variety / Population	Stages											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Krivogastani	08.04	20.04	27.04	13.05	20.05	27.05	31.05	05.06	13.06	20.06	25.06	10.07
Trebenista	08.04	20.04	27.04	13.05	20.05	27.05	31.05	05.06	13.06	20.06	25.06	10.07
Radolista	08.04	20.04	27.04	13.05	20.05	27.05	31.05	05.06	13.06	20.06	25.06	10.07
Bugarija	08.04	20.04	27.04	13.05	20.05	27.05	31.05	05.06	13.06	20.06	25.06	10.07
Kuceviste	08.04	20.04	28.04	13.05	20.05	27.05	31.05	05.06	13.06	20.06	25.06	10.07
Rajac	08.04	20.04	27.04	14.05	21.05	28.05	01.06	06.06	14.06	21.06	26.06	11.07
Slavuj	08.04	20.04	27.04	14.05	21.05	28.05	01.06	06.06	14.06	21.06	26.06	11.07
Lovkjen	08.04	20.04	27.04	14.05	21.05	28.05	01.06	06.06	14.06	21.06	27.06	10.07

Table 11
Reproductive development (organogenesis) in the organic production of oats 2007 year

Variety / Population	Stages											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Krivogastani	21.03	10.04	17.04	04.05	11.05	17.05	20.05	23.05	30.05	08.06	15.06	28.06
Trebenista	21.03	10.04	17.04	05.05	12.05	18.05	20.05	23.05	30.05	08.06	15.06	28.06
Radolista	21.03	10.04	17.04	05.05	12.05	17.05	20.05	23.05	30.05	08.06	15.06	28.06
Bugarija	21.03	10.04	17.04	05.05	12.05	17.05	20.05	23.05	30.05	08.06	15.06	30.06
Kuceviste	21.03	10.04	17.04	05.05	12.05	17.05	20.05	23.05	30.05	08.06	15.06	30.06
Rajac	21.03	10.04	18.04	05.05	12.05	18.05	21.05	24.05	30.05	08.06	16.06	30.06
Slavuj	21.03	10.04	18.04	05.05	12.05	18.05	21.05	25.05	31.05	09.06	16.06	30.06
Lovkjen	21.03	10.04	18.04	05.05	12.05	18.05	21.05	25.05	31.05	09.06	16.06	30.06

The nutrients that the plant takes in this stage do not affect the amount of yield.

The second stage starts and finishes at the end of stage yarovisation. Characteristic of this stage is the formation of the annular thickening, densely arranged one over another, at the base of the growth cone. They represent rudiments of the nodes of the culm, rudiments of the internodes and the rudiments of the leaves. During the first and second stage, the plants intensely ingrained and therefore require a sufficient amount of nutrients and soil aeration.

Differences in uptake and passage of these stages in individual varieties and methods of cultivation of oats were not observed.

The main requirement for plant uptake in the **third stage** of organogenesis is completed stage of yarovisation. If for

Table 12
Reproductive devolopment (organogenesis) in the conventional production of oats in 2005 year

Variety / Population	Stages											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Krivogastani	30.03	13.04	20.04	07.05	14.05	21.05	28.05	31.05	07.06	19.06	26.06	07.07
Trebenista	30.03	13.04	21.04	06.05	14.05	21.05	27.05	30.05	07.06	19.06	26.06	07.07
Radolista	30.03	13.04	20.04	07.05	14.05	21.05	28.05	31.05	08.06	19.06	26.06	08.07
Bugarija	30.03	12.04	20.04	06.05	14.05	21.05	27.05	30.05	07.06	19.06	26.06	07.07
Kuceviste	30.03	13.04	20.04	06.05	15.05	20.05	27.05	31.05	07.06	19.06	26.06	08.07
Rajac	30.03	13.04	21.04	06.05	15.05	21.05	28.05	31.05	07.06	20.06	27.06	08.07
Slavuj	30.03	13.04	21.04	06.05	15.05	22.05	28.05	31.05	08.06	20.06	27.06	08.07
Lovkjen	30.03	13.04	21.04	06.05	15.05	22.05	28.05	31.05	08.06	20.06	27.06	08.07

Table 13
Reproductive devolopment (organogenesis) in the conventional production of oats in 2006 year

Variety / Population	Stages											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Krivogastani	08.04	20.04	28.04	14.05	20.05	27.05	02.06	08.06	15.06	25.06	30.06	11.07
Trebenista	08.04	21.04	28.04	14.05	20.05	27.05	03.06	08.06	15.06	25.06	30.06	11.07
Radolista	08.04	20.04	27.04	13.05	20.05	27.05	03.06	08.06	15.06	25.06	30.06	11.07
Bugarija	08.04	21.04	28.04	13.05	20.05	27.05	03.06	08.06	15.06	25.06	30.06	10.07
Kuceviste	08.04	20.04	29.04	14.05	21.05	28.05	03.06	08.06	15.06	25.06	30.06	10.07
Rajac	08.04	21.04	29.04	14.05	21.05	28.05	03.06	09.06	16.06	25.06	30.06	11.07
Slavuj	08.04	21.04	29.04	14.05	21.05	28.05	03.06	09.06	16.06	25.06	30.06	11.07
Lovkjen	08.04	21.04	29.04	14.05	21.05	28.05	03.06	09.06	16.06	25.06	30.06	11.07

Table 14
Reproductive devolopment (organogenesis) in the conventional production of oats in 2007 year

Variety / Population	Stages											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Krivogastani	22.03	11.04	19.04	06.05	12.05	19.05	21.05	24.05	31.05	10.06	17.06	30.06
Trebenista	22.03	11.04	19.04	07.05	13.05	19.05	21.05	24.05	31.05	10.06	17.06	30.06
Radolista	22.03	10.04	18.04	07.05	13.05	19.05	21.05	24.05	31.05	10.06	17.06	30.06
Bugarija	22.03	11.04	19.04	06.05	12.05	18.05	22.05	24.05	31.05	10.06	17.06	30.06
Kuceviste	22.03	11.04	18.04	06.05	12.05	17.05	22.05	24.05	31.05	10.06	17.06	30.06
Rajac	22.03	11.04	19.04	07.05	13.05	19.05	23.05	26.05	01.06	10.06	18.06	01.07
Slavuj	22.03	11.04	19.04	07.05	13.05	19.05	23.05	26.05	01.06	11.06	18.06	01.07
Lovkjen	22.03	11.04	20.04	07.05	13.05	19.05	23.05	26.05	01.06	11.06	18.06	01.07

any reason it is not finished, further development of plants is discontinued and they can not enter in the light stage. At this stage forms the main stalk of the tassel, while in its lower part differentiate separate segments that will later develop into nodes of the main stalk of the tassel.

The **third stage** coincides with the stage end of tillering beginning of booting, i.e. stem growth (Figure 1).

It is noted that oats populations and varieties grown in organic production in this stage entered 1 to 2 days earlier compared with conventional production.

Fourth stage takes place when the plants are entered in a light stage. It is characterized with beginning spikelet formation in the tassel. According Jevtiħ (1992), IV, V, VI and VII stage of organogenesis goes in the booting stage of oat and the longer is the period between booting and tasseling more yieldable the variety will be (Figure 2).

In the fourth stage the plants elongate internode in the middle of the stalk. This stage usually can be completed in 7-16 days.

In the **fifth stage** oats formes flowers in the spikelet, glums and grain clippings, as well as the rudiments of the anthers and the pistil. Major impact on the adequate development of oats in this stage have temperature and light (Figure 3).

Insufficient nutrition and poor assistance with moisture lead to formation of reduced number of flowers in the spikelet. Knowing and determining the third, fourth and fifth stage of organogenesis are considered crucial for the yield. Knowing the characteristics of the stages and nutrient needs, the time for nourishing of oats can be successfully determined.

Characteristic of the **sixth stage** is the formation of generative organs: anthers with the sporogenous tissue in pollen grains and pistil with egg. As necessary conditions for normal development are noticed: long day with 10-12 hours of light, high intensity of light and water and food supplies. Optimum temperature for the development of this stage is 15-16°C (Vasilevski, 2004) (Figure 4).

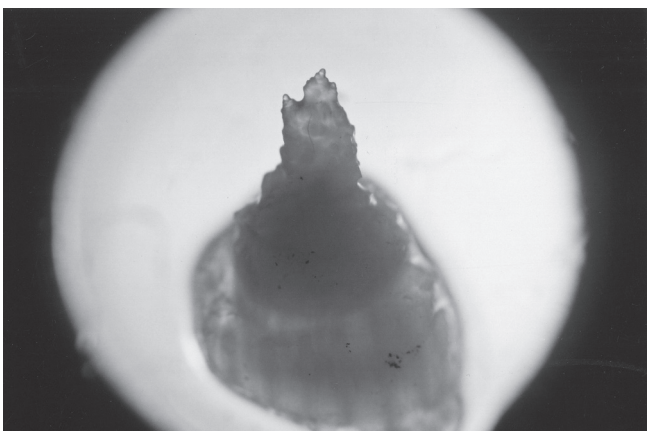

Fig. 1. III stage at oat

Fig. 2. IV stage at oat

Fig. 3. V stage at oat

Fig. 4. VI stage at oat

According Jevtić (1973), quote by Vasilevski (1980), even negligible not assistance of the plants with water leads to a significant reduction in the number of grains in the tassel and reduce of the yield.

In the third year of the examination, during this stage, there were quite precipitation (107.5 mm), which reflected the normal formation of flower organs, as well as reducing the sterility of flowers and increasing the number of grains per tassel.

In the **seventh stage** all formed parts of the tassel grow strongly accrue and the tassel rises to the leaf collar of the last leaf. At this stage fully is formed pollen, embryonic sac and the egg apparatus. Due to the strong growth of tassel organs, the tassel increases the dimensions and pressure and deformate the last collar leaf, which takes the form of a spindle (Figure 5).

Meteorological conditions at this stage can affect on the length of the tassel.

In our examinations, in the first year, as the most arid in this period, led to a shortening of the length of the tassel.

Stages of organogenesis from the eighth to the twelfth, or from tasseling to ripening coincide with the stages of vegetative growth, and because there are already elaborated, here will omit. **Eighth stage** coincides with the tasseling stage, the **ninth stage** coincides with blooming stage. In the **tenth stage** the grain is formed, from the moment of zygote formation in the embryonic sac to the stage milky maturity. **Eleventh stage** is called the stage of milky ripeness and coincides with the stage milky ripeness and the **twelfth stage** coincides with the stage ripeness.

As you can see, the year and the method of cultivation have a greater impact on organogenetic development. The method of cultivation, its influence highlighted by shortening the organogenetic development in organic production for 2-3 days in the first, second and third year.

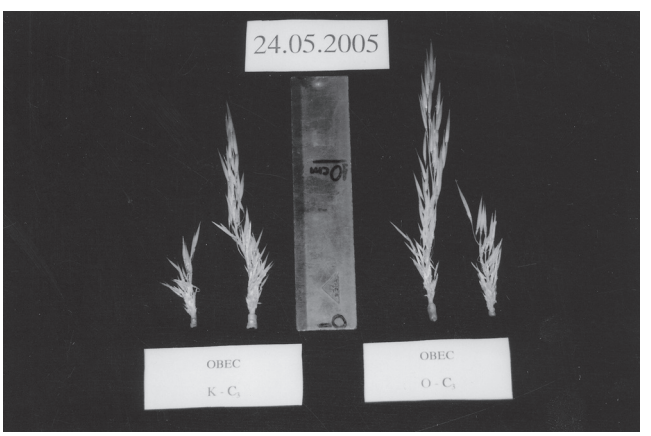

Fig. 5. VII stage at oat

Conclusion

Based on three years of research on the impact of the production system on the vegetative growth and reproductive development of oats, following conclusions can be drawn:

The speed and timing of the development of vegetative growth and the stages of organogenesis great depend on the complex of biological, climatic and agro-technical factors.

Knowing the stages of reproductive development is of great importance, because with separate agrotechnical measures, could affect on the proper targeting of the development of the fructify organs for maximum production.

Knowing and determining the third, fourth and fifth stage of organogenesis considered as crucial for the yield.

Knowing the characteristics of the stages and nutrient needs, the time for nourishing of oats can be successfully determined.

On the time and length of the growing stages greatly influence the characteristics of the variety and climatic conditions, especially temperature and humidity. Longest vegetation in both organic and conventional production we had in 2007, as a result of the precipitation that fell in May and June (total 153.1 mm).

Year and the way of growing systems have impact on the organogenetic development. The method of cultivation, its influence highlighted by shortening the organogenetic development in organic production for 2-3 days in the first, second and third year.

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