Changes in potato cultivation technology in Korça region as adaptation to climate change

Adrian Maho,[1] Besnik Skënderasi,[1] Magdalena Cara[2]

[1]Agriculture Faculty, Fan S. Noli University of Korça; [2]Faculty of Agriculture and Environment, Agricultural University of Tirana, Albania

Abstract

The production of agricultural crops depends on the optimisation rate of plant genetic factors, climatic and soil factors and the level of agrochemicals. These factors are in constant dynamism and also are the production of agricultural plants. Changing in climatic conditions of the area will necessitate bring changes in the genetic resources of the plants that will be cultivated as well as in the technology of cultivation. The study analyses the thermal and pluviometry performance of the Korça field, one of the areas with the best agricultural development and on this basis is experimented with the time of potato planting and the adaption to these changes. The analysis of climate variability and trends of ecological climate factors is determining for the sustainability of agricultural production. Especially the increase in temperature indicators requires adaptation to the changes in the technology of crops cultivation. The planting time, which is essentially determined by the optimum agronomic temperature, determines the entire biological cycle of the plant by directly influencing the morphologic and plant yield. Climate changes of the last decades make experimentation necessary to determine the optimal planting terms. Sustainable agricultural development determined by long-term climate change requires adaptation to these changes.

Introduction

Sustainability of agricultural crop production requires studies to recognise the climatic and especially microclimate conditions of different areas. Climatic and inter-annual fluctuations of meteorological elements affect the sustainability of agricultural crop production.

Regardless of the degree of adaptation of agricultural plants to the climate and the level of technology used, the annual fluctuations of climatic elements determine the level of production achieved. On the other hand, agricultural plants have differentiated climatic requirements and extend their cycle of development at different times of the year, but not always, climatic conditions are appropriate (Kopali and Doko, 2015).

The climatic features of different areas are studied and expressed by climatic classifications (Climate Alterations of Albanian Territory, IHM, 1978), but in the case of agricultural plants the climatic environment should be characterised by the agro-climate classification of the areas, being within the same different plant areas react in different forms. The agro-climate classification of different agricultural areas enables the agro-climatic regionisation of the territory (Peçuli and Kopali, 2007), which allows the construction of suitable technologies and plant selection in accordance with their characteristics.

In 2016, the global average temperature was about 1°C warmer than in pre-industrial times. The warmer the world is, the more serious are the risks posed to the environment, human society and the economy (Juniper and Shuckburgh, 2017).

According to studies conducted (IPCC, 2007), Southern Europe, part of which is also Albania, is getting dryer and hotter with less precipitation. Agriculture and rural areas will be more affected by climate change and especially from the lack of rainfalls. A correlation with the Human Development Index suggests that in many less developed - and thus more sensitive and less adaptable - countries climate is expected to change more strongly than in more developed (Baettig *et al.,* 2007).

Current knowledge based on a large set of evidence shows that most of the agricultural lands analysed have had a significant increase in minimum and maximum temperatures from the beginning of the twentieth century (Donat *et al.,* 2013).

In fact, according to studies (Hansen *et al,* 2012), there is only one average level of reliability in reducing the daily thermal excursion and compressive impact on the distribution of probability and this is still a matter of discussion. But the biggest damage to agricultural crops comes from low temperatures when they cross the thermal thresholds for certain crops than from the high crops. Precisely, the definition of thermal minimums is with particular importance for the cultivation of agricultural plants.

The area of the Korça field, is part of the southern Mediterranean pre-mountainous area of the Albanian territory, is the most productive agricultural areas. This area extends to the altitude of 850 m above sea level, in geographic width 400 and 36' and geographical latitude 200 and 44'.

The purpose of this study was to analyse the climatic performance of the Korça area, referring to the main indicators and their

Correspondence: Adrian Maho, Agriculture Faculty, Fan S. Noli University of Korça, Bulevardi Rilindasit 11, Korça, Albania.
E-mail: maho.adrian@yahoo.com

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variations in time especially temperature changes in the potato planting times.

Plant yield in agro-ecosystems varies from one year to the other; however the cultivation techniques are the same. From this point of view we say that this variability comes as a result of the direct or indirect impact of climatic factors that are not depend the human being (Peçuli and Kopali, 2007).

Fluctuations of inter-annual climate elements directly affect the intensity of growth and production of agricultural plants. Climate changes, especially temperature, reflect changes not only in terms of seedling but also in another important phase of tuber formation. At 29°C soil temperature the tuber formation is interrupted even if humidity conditions are appropriate. High temperatures combined with the long day cause the return of stubble to bouncing on the surface and grow without giving tubers. We highlight that currently potato growers in Korça area have solved the problem of water balance through investments in rainfall plant systems.

Potato requirements on environmental conditions

Potato is a plant of great plasticity that acclimates quickly. It is cultivated in the northern areas of agricultural production up to 700 and 40' north latitude and equatorial areas of southern latitude 500. It is cultivated from seacoast to heights 4000 m above sea level in central Andes Mountains.

In its country of origin in Chile the formation of tubers is done in conditions of abundant humidity and air temperature around 15°C with day length 12-15 h and relative humidity of air 75%.

So potato that in its phylogeny has been adapted to the conditions of a low temperature, abundant humidity (especially that of air) and average length of day.

Warmth demands

Though it is cultivated in all climatic zones of the globe (700 north, 300 southeast), it should be noted that the highest and sustainable yields from this plant are taken in medium moderate vegetation regions during vegetation period.

The germination of potato tubers is realised when the soil temperature at the depth of their laying (6-12 cm) is above 7-8°C and they develop as fast as the temperature is higher.

When the soil temperature is 11-12°C, the germination appears to be after 23 days of it is planting, at 14-15°C after 17-18 days, at 18-25°C after 12 to 13 days and at 27-28°C after 16-17 days.

In the germination time influence has also the potato cultivar, it is shorter for early cultivars and vice versa (Mecollari *et al.,* 2002).

The optimal temperature for its growth and development throughout the plant period is 15-17°C.

Absic acid is the inhibitor of germination. Some cytokines and especially Chynetina are part of the hormonal tuberous substances. Low temperatures help in the synthesis of tuberous matter, while the high temperature helps the processing of growth material.

Potato is highly susceptible to high temperatures above 25-30°C and below 0°C.

The continuous and long-term action of high temperatures above 30°C at the time of tuber formation especially at night brings the so-called *ecological degeneration*. As a consequence, there is a decrease in the quantity and quality of production and production capacity of the tubers for the next year.

The minimum biological temperature for tuber germination is 4-5°C while the optimum agricultural temperature is above 7-8°C when this temperature is stabilised at a depth of 6-10 cm this determines the optimal agronomic time of planting. At this temperature germinations appear on average after 20-25 days and when they are budded the sowing-germination period is trimmed for 7-10 days. The growth and development of the ground part is carried out regularly when the air temperature is 18-22°C and sufficient moisture. Under these conditions, CO_2 captured and the formation of carbohydrates is strongly carried out. Outside these limits, CO_2 absorption is weakened and at 40°C it is interrupted.

Decreasing of the temperature also has harmful action on photosynthesis so when the soil temperature drops to 10-14°C significantly the absorption of nitrates (20-60% less) and phosphoric acid (19-33% less) leads to poor development of the vegetative mass.

Ecological degeneration

Potato seed degeneration is not only caused by viruses but also by ecological conditions, high temperatures and lack of moisture.

High temperatures during sowing-germination phase over 15-17°C, especially those during the tubing phase above 25-30°C (when accompanied by a lack of moisture) cause ecological degeneration of potato.

In these temperature conditions as above negative phenomena are beginning to emerge, rapid transition (prematurely) of the development stages and the rise of the ammonium nitrogen content that causes their aging (tubers).

All of these are associated with a pronounced weakening of the plant's organism, making it easily and severely affected by various fungal diseases from unfavourable environmental factors, significantly reducing its production and quality. But it does not end in such a way that degeneration is a hereditary phenomenon and when production is preserved will be used as planting material for the next year, the tubers do not germinate or give weak and degraded germination in the shape of inflorescence or bulbs. It is worth pointing out that filaments and bulbs as germination shape that deviate from normal are a consequence not only of ecological degeneration, but also of viruses, physiological tuber condition and conservation conditions.

Recognising and evaluating the highly negative effect of ecological degradation on the production and quality of potatoes, changes must be made to: i) planting in the most optimal terms by type of cultivation and climatic zones; ii) during the plant period, care should be taken in meeting the needs of water plants because it is connected to the temperature regime and consequently the normal growth of plants. Thus according to surveys in irrigated parcels twice the filaments was 0-3% to 17-35% at not-irrigated parcels. We point out that sowing dates determine not only the germination of plants but also the time when the plant enters the tubing. As soon as possible (within optimal conditions) the potato is sow, sooner it forms the tubers. This is an advantage in terms of optimum tubing temperatures of 23-25°C. On the contrary, planting in late time postponed the tubing period at the beginning of July, with high probability for temperatures higher than 25°C. This results in a significant reduction in the tubing period and causes ecological degradation of potato.

Based on assessments of air temperature performance and precipitation in some of the meteorological locations of the Korça field of the National Meteorological Monitoring System for March and April of the last decade and especially for the experimental years 2016-2018 Metrology Bulletins Institute of Geosciences, Energy, Water & Environment are achieved some conclusions.

Temperatures measured after March 25 is always above the biological minimum required by the potato culture.

Based on the temperature data for the months of March-April and compared with the climatic data (referring to the period 1961-1990), generally maintained in most meteorological stations temperatures of about 0.5°C to 2.5°C higher than normal, due to the presence of warm air and an atmospheric stability with a longer duration, whereas in March 2017 temperatures of about 2°C to 4°C were higher than normal (Institute of Geosciences, Energy, Water & Environment Bulletin, March 2017) The weather during March 2018 was characterised by temperatures of around +1.3°C above norm values (Institute of Geosciences, Energy and Water & Environment Bulletin March 2018). These data are illustrated in Figures 1-4.

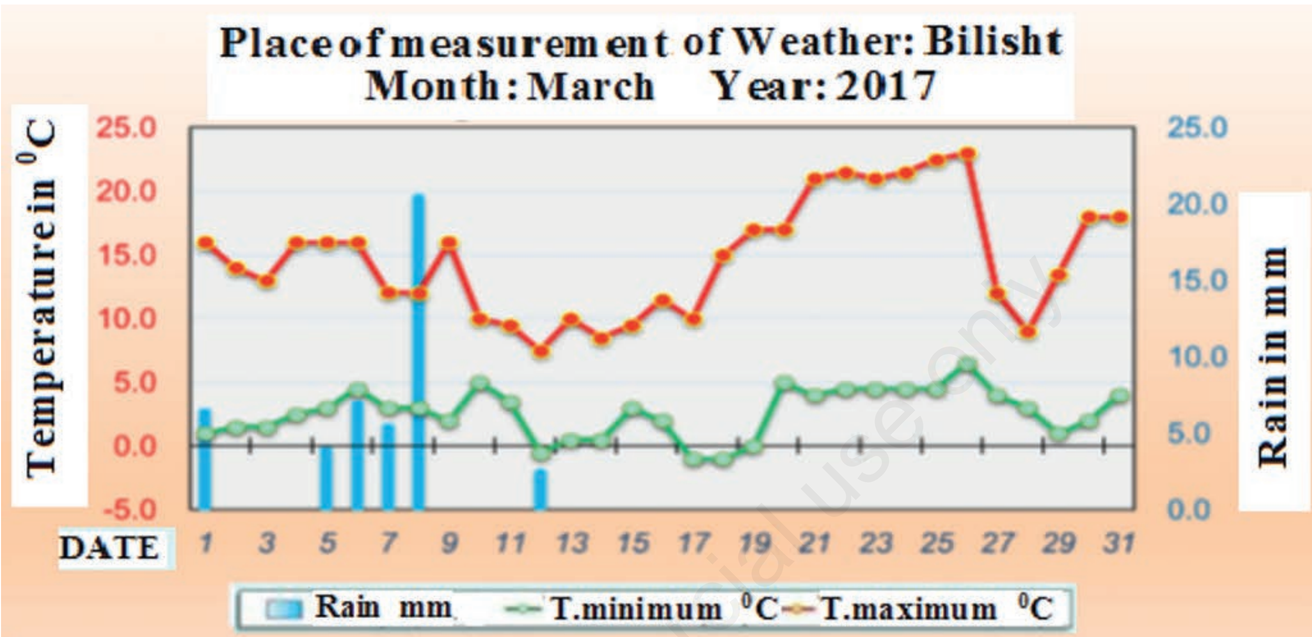

Figure 1. Climate Indicators by Institute of Geosciences, Energy, Water & Environment Bulletin, March 2017.

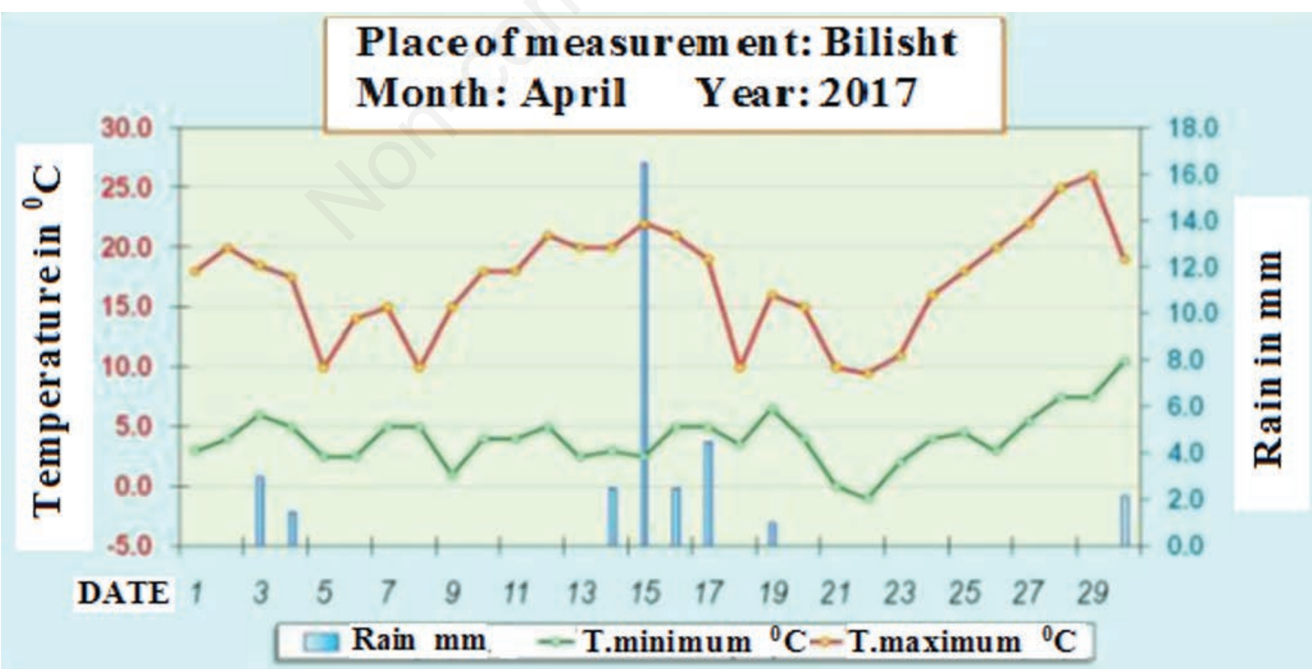

Figure 2. Climate indicators according to the Institute of Geosciences, Energy, Water & Environment Bulletin, March 2017.

Materials and methods

The study was conducted during the years 2016-2018 in the EDE area of the Fan S. Noli University, Korça with mechanical SAM. The study was performed according to the randomised 4-block scheme. The study included the 3 main cultivars that are planted in the area of Korça (*Fabula, Agria* and *Spunta*) with the same reproduction, grade A with seed obtained from import.

The surface of each variant was 21 m^2 with dimensions 6×3.5 m. In each variant, 5 rows were placed.

Planting distances are 70×30 cm. The size of the planted seed is 35-45 mm.

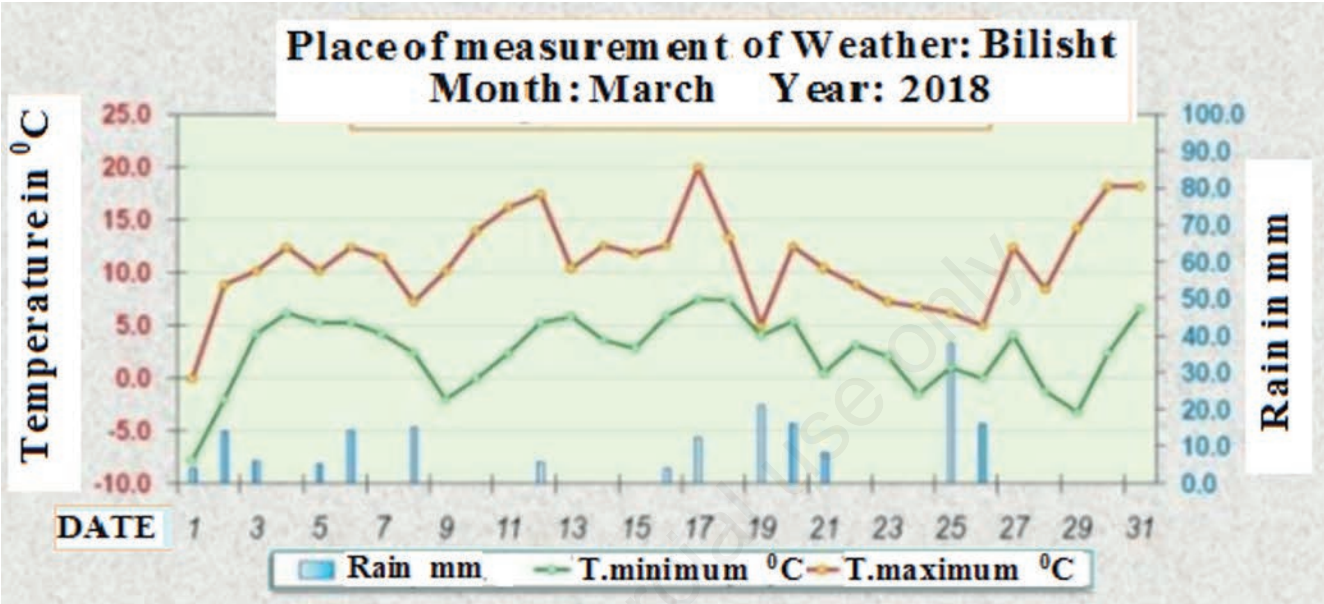

Figure 3. Climate indicators according to the Institute of Geosciences, Energy, Water & Environment Bulletin, March 2018.

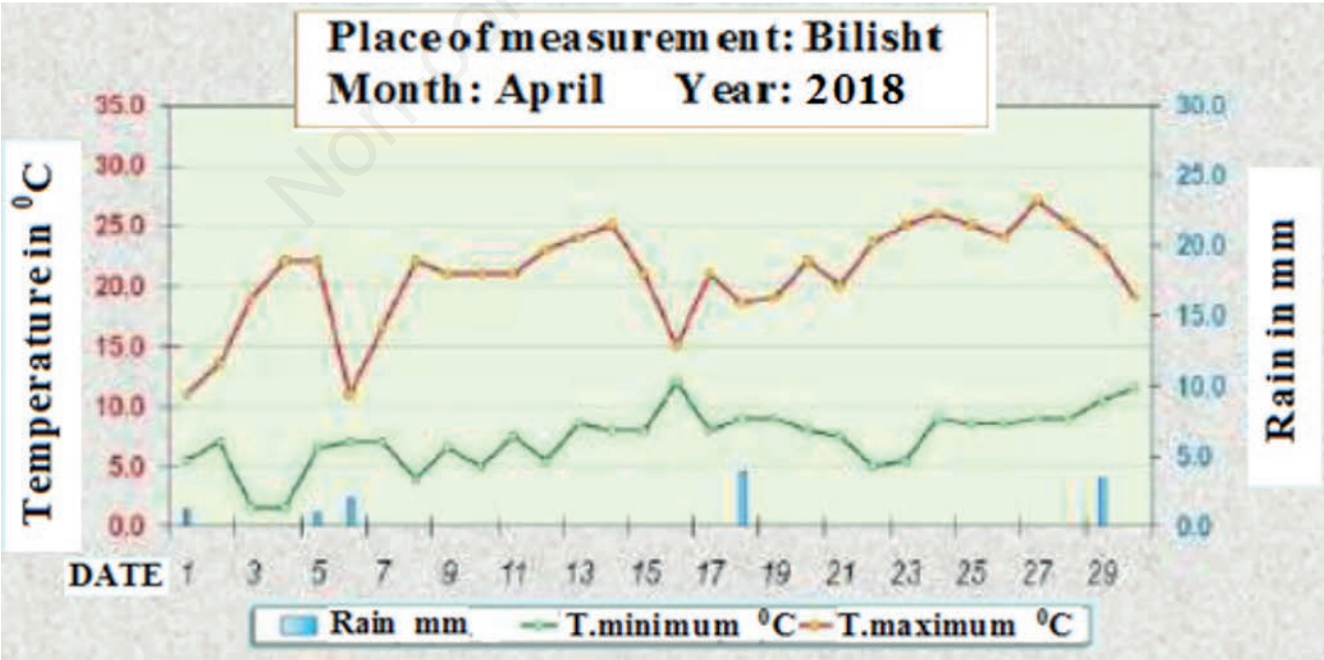

Figure 4. Climate indicators according to the Institute of Geosciences, Energy, Water & Environment Bulletin, April 2018.

The planting took place on March 25, April 5, April 15 and April 25. During the study where taken, measurements, counts, weights, observations for the transition of plant development phases, dynamics of their growth, contact with diseases, characteristics and production qualities, *etc*..

Climate indicators data were taken from the meteorological monitoring system of Korça National Meteorological Monitoring System (Published in the Meteorology Newsletter at the Institute of Geosciences, Energy and Water & Environment).

Temperature data was analysed by making comparisons with temperature data in the previous 30 and 10-year-olds. The analysis focused on the period from March 20 to September 30 because it is related to the period of potato cultivation.

Field observations in the trail

To explain more objectively the impact of the factor, planting time in plant development and their yield should be field observations and to maintain the phenological phases and biometric measurements of the plants. These phenological phases were analysed: i) planting date; ii) germination date (start and end); iii) flowering (start and end); iv) ripening (start and end).

Defining the phenological phase is done by eye and counting.

The starting phase will be considered when 10% of the plants have entered that stage, and complete when 75% of the plants are in phase. Blooming is taken when 90% of the plants are over flowering and there are no flowers.

Biometric measurements are made before harvesting (in full ripening) in the set for taking the phases and at the end are taken these indicators: i) planting season of cultivars; ii) plant growth dynamic; iii) morphological characteristics of cultivars; iv) number of clusters and tubers for plants; v) disease infection rate; vi) tuber size classification; vii) production of cultivars under different planting times.

Agro-technique in experimental fields with potatoes

In the experimental field with the exception of study factors (planting time and potato cultivar), agro-technology is the same for the entire experimental field. The most important moments are:

- *Soil preparation*. Made of 25-30 cm deep. Blade to provide a short coat for laying tubers.

- *Basic fertilisation.* Usually it is carried out with 4 kv/ha DAP, and 2 kv/ha K_2SO_4 which overturn the soil plowing. Furrow was opening with cultivator 70 cm. Dispersion disinfection of soil with 30 kg/ha Phorate (*O-Diethyl S-ethylmercaptomethyl dithiophosphate*), which is classified as a member of the *Dithiophosphate O-esters*. Covering tubers with hoe in the depth of 6 to 8 cm.

Services made:

- *Harrowing*. Usually it is necessary to carry out 2-3 harrows with intervals of 10 to 12 days until the conditions allow entering on the parcel.
- *Supplementary fertilisation*. The first hand of supplementary fertilisation is done with 2 kv/ha during the first and second harrowing process. The amount of fertiliser is based on the nutrients that the soil has.
- *Irrigation*. Three irrigations are carried out. Potato cultivators tested are irrigated in rain form using a rate of 600 m^3/ha or 1.26 m^3/variant (variant is 21 m^2). The irrigation time is determined on the basis of soil pedology and its irrigation ability. Intervention with irrigation was carried out when the water content on the ground was at 75% of the water capacity.
- *Treatments* against the pest with Calipso (*Thiacloprid*) 0.04%, 500 L/ha solution.

Results and discussion

Based of field observations, resulted these experimental data (3-year averages 2016-2018): the cultivation period of cultivars is reflected in the Table 1.

Based on the experimental observations it turns out that: i) the blossoming of potato cultivars planted on 25 March occurs from 13 to 15 June. We point out that the blossoming period is the period with the highest productivity of assimilates. Earlier plantings cultivars postponed this period, increasing the possibility of coinciding with higher temperatures than 25°C by placing plants in conditions with problematic temperatures; ii) the crop cycle (germination-ripening) of potato cultivars planted on 25 March is longer than the same crops planted at later times. There is a positive correlation between crop cycle length and plant production.

The growth dynamics of crops

The measurements were performed over 10 plants in the middle row of variants, defined by the milestones, every 10 days starting from the end of the germination to the end of the flowering.

Number of barks and tubers for plant

Measurements were performed over 10 plants in the middle rows of variants, defined by milestones. The counting is done in the blossoming phase of plants. While the number of tubers has been carried out on these plants before harvesting. The data of these measurements is presented in the Table 2. From the above data are noticed these occurrences: i) the germination period in early sowing is longer; ii) plant length in early planting times is bigger; iii) daily growth dynamics of plants is higher in late planting time; iv) the number of stalks and tubers per plant and the tuber/stalk ratio does not represent statistically changes according to the different planting time factor, changes resulting from different potato cultivars.

Morphological characteristics of cultivars

Field descriptions are carried out following the dynamics of plant development. Regarding to these characteristics, no change in the condition of planting are observed.

The data for these observations are presented in Table 3.

Classification according to the tuber size

This expresses the report that tuber fractions take in overall production. Measurements were performed over 10 plants in the middle row of varieties, defined by milestones, and divided into 3 fractions by size: tubers below 35 mm (out of standard), tubers 35-55 mm (for seed production) and tubers over 55 mm (for consumption). Each fraction is weighed individually and on this basis is determined the percentage that each faction plays in the overall production. The data are presented in Table 4.

Based on the experimental results we conclude that tuber size indicators are influenced by both experimental factors, sowing time and cultivar. These changes are statistically proven. Sowing varieties at the earliest times represent the largest tubers.

Infection ratio of diseases during vegetation and conservation as well as chemical and technological qualities

The observation was carried out in the blossoming phase of plants mainly for viral and fungal diseases such as *Smut, Alternaria, fungal shriveling, Rhizoctonia*, *etc*.

For the infection ratio of disease during the conservation peri-

Table 1. Crop period of potato cultivars planted in different periods of time.

No.	Variants	Planting	Germination	Blossoming	Ripening	Plant period per day (germination-ripening)
1	Cv. Fabula 25 March	25 March	23 April	15 June	9 August	108
2	Cv. Fabula 5 April	5 April	2 May	22 June	16 August	106
3	Cv. Fabula 15 April	15 April	10 May	30 June	22 August	104
4	Cv. Fabula 25 April	25 April	19 May	5 July	27 August	100
5	Cv. Agria 25 March	25 March	22 April	14 June	5 August	104
6	Cv. Agria 5 April	5 April	30 April	21 June	11 August	103
7	Cv. Agria 15 April	15 April	8 May	28 June	19 August	101
8	Cv. Agria 25 Prill	25 April	17 May	2 July	27 August	100
9	Cv. Spunta 25 March	25 March	22 April	13 June	3 August	103
10	Cv. Spunta 5 April	5 April	30 April	20 June	10 August	102
11	Cv. Spunta 15 April	15 April	8 May	27 June	15 August	99
12	Cv. Spunta 25 April	25 April	17 May	1 July	22 August	97

Table 2. The growth dynamics of plants.

No.	Variants	Plant height (cm)	Length of the period germination, blossoming	Dynamics of growth day to day plants (cm)	Average number of clusters for plants	Average number of tubers per plant	Rate tubers/ clusters
1	Cv. Fabula 25 March	72	53	1.36	4.3	8.6	2.5
2	Cv. Fabula 5 April	70	51	1.37	4.3	8.5	2.5
3	Cv. Fabula 15 April	70	51	1.37	4.2	8.6	2.3
4	Cv. Fabula 25 April	69	47	1.47	4.1	8.4	2.4
5	Cv. Agria 25 March	68	53	1.28	3.7	8.2	2.4
6	Cv. Agria 5 April	66	52	1.27	3.75	8.1	2.35
7	Cv. Agria 15 Prill	65	51	1.27	3.6	8.4	2.3
8	Cv. Agria 25 April	65	46	1.41	3.6	8.2	2.3
9	Cv. Spunta 25 March	58	52	1.11	4.6	10.5	2.2
10	Cv. Spunta 5 April	58	51	1.14	4.5	10.4	2.3
11	Cv. Spunta 15 April	57	50	1.14	4.5	10.6	2.2
12	Cv. Spunta 25 April	55	45	1.22	4.4	10.3	2.1

od, there were putted after harvesting on conservation in a storage place 2 boxes with tubes from each cultivar (100 tubers) during the winter and in April of the following year, observations were made for manifestations of the phenomenon of fibrillation, budding and diseases of decay. For the chemical and technological qualities after harvesting, the tuber test for dry matter and amide content. Amidone analysis was performed with the amidone apparatus in 3 samples for each cultivar. While dry matter is determined by laboratory analysis. The data are presented in Table 5. From the analysis of the above indicators it results that there is a strong correlation between the planting factors, the cultivar and the indicators of the infection rate from diseases during vegetation period and during conservation. Early planting cultivars present lower indicators of infection during vegetation and during conservation.

Production of potato cultivars in different sowing times

Harvesting of the experiment production was carried out on the technical ripening time of tubers. Harvesting and collection is done separately for each variant of repetition. Based on the production and the harvested surface area is calculated the yield (average 3-year converted yield per 1 ha), which is presented in Table 6. The collected data are subject of the two-factor variance analysis. The two factorial analysis of the variance is presented in Tables 6 and 7.

Conclusions

From the processing of experimental data (Table 8) results: Factor A - Planting time brings statistically proven differences with certainty 99% (Calculated F 507.8 > Table F 4.44 with 99% probability). The best time for potato planting in the area of Korça is March 25-30. As a result of climate change, potato planting should take place about ten days before the usual planting.

The highest productivity of potato planted on March 25-30 is explained by the following facts: i) the blossoming of potato cultivars planted on 25 March occurs from 13 to 15 June. Previous plantings postponed the blossoming period, increasing the possibility to coincide with temperatures higher than 25°C by putting the plants under conditions with problematic temperatures; ii) the crop cycle (planting - ripening) of potato cultivars planted on 25

Table 3. Morphological characteristics of cultivars.

No.	Cultivar	Morphological characteristics of plants				
		Clusters position	Leaves size	Leaves colour	Flower colour	Bark colour
1	Cv. Fabula	Angular	Average big	Light green	Light purple	Yellow
2	Cv. Agria	Straight	Medium	Light green	White	Yellow
3	Cv. Spunta	Angular	Medium	Dark green	White	Yellow

Table 4. Classification based on tuber size.

No.	Variants	Tubers under 35 mm%	Tubers 35-55 mm%	Tubers mbi 55 mm%	Average weight of 1 tuber (gr)
1	Cv. Fabula 25 March	4.1	26	69.9	155.5
2	Cv. Fabula 5 April	4.5	28	67.5	145
3	Cv. Fabula 15 April	4.9	30	65.1	140
4	Cv. Fabula 25 April	5.4	32	62.6	130
5	Cv. Agria 25 March	5.6	38	56.4	115
6	Cv. Agria 5 April	6.2	41	52.8	105
7	Cv. Agria 15 April	6.5	44	49.5	102
8	Cv. Agria 25 April	6.8	46	47.2	101
9	Cv. Spunta 25 March	8.5	35	56.5	119
10	Cv. Spunta 5 April	8.1	37	54.9	108
11	Cv. Spunta 15 April	8.7	39	52.3	104
12	Cv. Spunta 25 April	9	42	49	102

Table 5. Infection rate from vegetation and conservation diseases as well as chemical and technological qualities.

No.	Variants	Infection rate from viruses %	Fibrillation	Budding	Dry putrefaction	Content of dry matter %	Amidine content %
1	Cv. Fabula 25 March	0.5	3.4	1.8	8	21.2	15.3
2	Cv. Fabula 5 April	0.6	3.8	2.2	9.2	21.2	15.3
3	Cv. Fabula 15 April	0.65	4.6	2.5	10	21.3	15.5
4	Cv. Fabula 25 April	0.7	5.5	2.9	10.5	21.35	15.7
5	Cv. Agria 25 March	2.2	11.5	4.8	2.3	20.25	13.8
6	Cv. Agria 5 April	2.5	12.2	5.2	2.7	20.3	13.9
7	Cv. Agria 15 April	2.8	12.8	5.7	2.9	20.3	13.9
8	Cv. Agria 25 April	3	14	6.2	3.4	20.35	14
9	Cv. Spunta 25 March	1	3.8	2.2	4.8	20.2	14.7
10	Cv. Spunta 5 April	1.1	4.2	2.5	5.3	20.2	14.75
11	Cv. Spunta 15 April	1.2	4.7	2.9	5.8	20.3	14.8
12	Cv. Spunta 25 April	1.3	5	3.5	6.6	20.3	14

Table 6. Production of potato cultivars in different sowing times.

No.	Variants	Repeating I	Repeating II	Repeating III	Repeating IV	Σv Sum of variants	Average kv/ha
1	Cv. Fabula 25 March	495	520	515	510	2040	510
2	Cv. Fabula 5 April	485	470	465	460	1880	470
3	Cv. Fabula 15 April	400	405	440	435	1680	420
4	Cv. Fabula 25 April	361	364	352	363	1440	360
5	Cv. Agria 25 March	444	445	447	464	1800	450
6	Cv. Agria 5 April	394	398	382	386	1560	390
7	Cv. Agria 15 April	363	358	354	365	1440	360
8	Cv. Agria 25 April	305	315	306	314	1240	310
9	Cv. Spunta 25 March	473	481	462	464	1880	470
10	Cv. Spunta 5 April	435	439	428	458	1760	440
11	Cv. Spunta 15 April	366	363	379	372	1480	370
12	Cv. Spunta 25 April	307	298	289	306	1200	300
	Repetitions sum	4828	4856	4819	4897	19400	404.17

Table 7. The amount (total) of potato cultivar test × sowing time.

Planting time (factor A)	Potato cultivar (factors B)			Sum
	Cv. Fabula	Cv. Agria	Cv. Spunta	
25 March	2040	1800	1880	5720
5 April	1880	1560	1760	5200
15 April	1680	1440	1480	4600
25 April	1440	1240	1200	3880
Sum	7040	6040	6320	19,400

Table 8. Statistical analysis of the variance of the production of potato cultivars planted in different period of time.

Source of change	Degrees of Freedom	Quadratic sums	Quadratic averages	Calculated F	Table F	
					95%	99%
Total	47	197.673	-	-	-	-
Repetitions	3	308	102.7	0.997	2.89	4.44
A	3	156.900	52.300	507.8	2.89	4.44
B	2	33.267	16.634	161.5	3.29	5.31
AB	6	3.800	633	6.14	2.39	3.41
Mistake	33	3.398	103	-	-	-

March is longer than the same crops planted at later times. There is a positive correlation between crop cycle length and plant production. According to the data in Table 2-5 it is concluded: i) the period germination - blossoming at the earliest planting crops is longer; ii) plant length in early planting times is bigger; iii) tuber size indicators are influenced by both experimental factors, sowing time and cultivar. These changes are statistically proven. Varieties of planting in the earliest times represent the largest tuber: i) there is a strong correlation between planting factors, cultivar and indicators of the infection rate from vegetation and conservation diseases; ii) Early planting cultivars show lower levels of diseases infection during vegetation and conservation.

In conclusions: i) the best producer variant is the cultivar of *Fabula* potato planting on March 25-30; ii) the weakest production variant is the potato cultivar *Spunta* planted on April 25-30; iii) Factor B - Potato cultivar brings statistically proven variations with 99% confidence in plant productivity. These changes are reflected in growth indicators as well as plant resistance against disease (F calculated 161.5 >5.31 F table with certainty 99%); iv) Factor AB - Planting time × Potato cultivar brings statistically proven variations with 99% confidence (calculated F 6.14 >3.41 F tabular with 99% confidence).

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