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FORMATION OF ECONOMIC VALUABLE INDICATORS IN *SATUREJA HORTENSIS L.* DEPENDING ON GROWING AGROTECHNICAL METHODS IN THE CONDITIONS OF THE CENTRAL FOREST-STEPPE

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Problem statement. Over the past decade, southern regions that were moderately arid in the previous decade have moved into the category of severely arid, and poorly humidified regions have moved into moderately arid [1]. With the expected increase in air temperature in the Northern Hemisphere, Ukraine's food security will largely depend on how effectively agriculture adapts to future climate change [2]. The impact of climate change on agriculture is manifested in an uncharacteristic lack of precipitation. In this case, there is a need for artificial irrigation, even in those regions where natural moisture was previously sufficient.

Recently, considerable attention of farmers in different regions of Ukraine is paid to the cultivation of non-traditional and rare crops. One of the most popular spicy plants, which are grown and used by many peoples of the world, is *Satureja hortensis* L. In climate change conditions towards global warming, it is important to study possible cultivation areas and agricultural techniques for growing this crop to obtain high economically valuable indicators.

Analysis of recent research and publications. *Satureja hortensis* L. is a typical Mediterranean species, widely cultivated as a spicy and decorative plant belong to the Lamiaceae family (*Lamiaceae Martinov)* [3]. The homeland of *Satureja hortensis* L. is the eastern regions of the Mediterranean and the Black Sea region. It is widespread in Western and Eastern Europe, North America, Canada, as well as in small areas in the Caucasus, Crimea, Uzbekistan, Turkmenistan and Moldova [3, 4].

Satureja hortensis L. has been used as a spice since ancient times. Due to its rich aroma, it is used more often than *Satureja montana*. The dried above-ground part of the plant is added to commercial spice mixtures for many food products to provide a pleasant aroma and taste. It is an essential element in traditional meat dishes in Bulgaria and Romania. It is also often consumed as a tea [5,6].

Scientists have proven that the composition of the above-ground mass of *Satureja hortensis* L. is dominated by essential oil, polyphenols and flavonoids, and natural products to which the plant is added have medicinal properties. [5, 6, 7].

Satureja hortensis L. is used as a folk remedy for the treatment of various diseases [6, 8]. It has demonstrated antispasmodic, antidiarrheal, antioxidant, sedative, antimicrobial properties, including protective effects against Jurkat T-cells, Alzheimer's disease, cancer, infections, cardiovascular diseases, diabetes and cholesterol [5, 8, 9].

Due to its high nutritional value, the leaves and stems of this plant are used as animal feed [8]. It is a good honey plant. The essential oil obtained from *Satureja hortensis* L. plants can be used in the perfume and cosmetic industry [5].

According to literature, the mass fraction of essential oil obtained from *Satureja hortensis* L. plants in the Kherson region is 0.35% of the raw mass [10]. In Iran, its content ranges from 0.5% to 2.9% [7].

In the essential oil of plants, 29 components have been identified. A characteristic feature of the essential oil is the presence of such main components as carvacrol (11-83.3%), thymol (0.3-28.2%), γ-terpinene (0.5-39%) and p-cymene [5, 7, 10].

According to the results of studies conducted in Turkey, climatic factors have a significant impact on the yield and biochemical indicators of *Satureja hortensis* L. [11]. Studying the ecological and biological features of *Satureja hortensis* L. introduced in the conditions of Polissya, Ukrainian researchers claim that this species is well adapted and is particularly promising for the agricultural sector in this region. [12]. Conducting research on the productivity of *Satureja hortensis* L. in the Southern Steppe conditions, scientists from the Mykolaiv Agrarian University conclude that its growth and development depends on the biological characteristics of the variety, agrotechnical methods of cultivation and weather conditions [3, 13].

The purpose of the article is to study the dynamics of growth and development, the formation of economically valuable traits of *Satureja hortensis* L. depending on the timing of sowing and moisture conditions in the conditions of the Central Forest-Steppe.

Materials and research methods. The research was conducted in 2024 in the conditions of the Central Forest-Steppe of Ukraine in the Lysyansky district of the Cherkasy region. The climate of the Central Forest-Steppe is temperate continental, with relatively mild, little-snowy winters and warm, moderately humid summers. The area is located on the Dnieper Upland of the East European Plain, in the basin of the Gnily Tikich River [14]. The soil of the area where the research was conducted is typical black soil. The soil is heavy loam in terms of granulometric composition. The humus content in the arable layer is 4.58%.

The material for the research was the sample *Satureja hortensis* L. No. 6-23. The seeds of this sample were sown in two rows with a row spacing of 50 cm. The first sowing period was carried out in the third decade of April. A decade later, in the first decade of May, the second sowing period was carried out. The crops were moistened in three ways, which included intensive drip irrigation, moderate drip irrigation and natural moistening.

Phenological observations were made on the crops according to known methods [15, 16]. The following phases were noted: emergence of seedlings, tillering, budding, flowering (beginning, mass, end), fruiting (beginning, mass, end). Biometric measurements were made every two weeks during the vegetation of the plants. The height and diameter of the plants were measured. During the plants vegetation, the above-ground mass of the plant raw materials was determined every two weeks. The mass fraction of essential oil in the plant raw materials was determined according to the phases of plant development by the Ginsberg method on the Clevenger apparatus and was calculated on the absolutely dry mass [17]. Distillation of the essential oil was carried out 4-5 days after irrigation.

Research results. *Satureja hortensis* L. is an annual herbaceous plant 50-70 cm tall. The stem is strongly branched, woody at the base, anthocyanin-colored in the lower part, green in the upper part. The leaves are linear-lanceolate, 1.5-2.5 cm long. The flowers are small, light purple with purple spots. The root system is poorly developed and is located mainly in the upper soil horizon. *Satureja hortensis* L. is propagated by sowing seeds directly into the soil. Seed germination is very short-lived, and three years after harvesting it practically does not germinate [18]. *Satureja hortensis* L. is a thermophilic plant. It is able to tolerate short-term temperature drops, but minor frosts lead to its death [13, 19].

Sowing on the plots was carried out in the third decade of April (April 24) and the first decade of May (May 6). The emergence of seedlings was noted at the first sowing time on the 7th day, and at the second sowing time on the 6th day. The plants grew slowly at first. 20 days after the beginning of the emergence of seedlings, the tillering phase was noted for plants sown in the third decade of April (the first sowing time), and after 17 days the tillering phase was noted for plants sown at the second sowing time.

The beginning of the budding phase was observed 44 days later (in the first decade of July) from the beginning of the tillering phase for plants from the first sowing period. In plants from the second sowing period, the beginning of budding occurred after a shorter period (42 days later). The duration of the interphase period from budding to the beginning of flowering for plants from the first sowing period was 13 days, and for plants from the second sowing period it was shorter by 5 days.

The beginning of flowering for both sowing dates was noted in the second decade of July. Plants from the first sowing date bloomed simultaneously in all moisture options. 3 days later, flowering of plants from the second sowing date was also noted simultaneously in all moisture options. The end of flowering – beginning of fruiting phase occurred at the beginning of the second decade of August.

Studying the dynamics of plant growth and development, it was found that initially the plants grew very slowly at both sowing dates. There was a noticeable acceleration of plant growth at the tillering phase. At this phase, the height of the plants from the first sowing date varied from 13 to 18 cm, with a diameter of 8.5 to 19.5 cm. (Fig. 1). The mass of the above-ground part of one plant at this time ranged from 1.0 to 12 g. (Fig. 2).

After two weeks, the height of the plants varied from 29 to 36 cm, with a diameter of 30 to 38 cm. The above-ground mass of the plants also increased, ranging from 20 to 60 g. At the budding – beginning of flowering phase, the height of the plants varied from 47 to 55 cm, with a diameter of 40 to 50 cm. The above-ground mass indicators ranged from 86 to 102 g. The height of the plants also increased at the mass flowering phase, which varied from 45 to 57 cm, with a plant diameter of 40 to 52 cm. At the same time, the above-ground mass indicators ranged from 62 to 121.7 g per plant.

Plants from the first sowing period had the highest indicators of height, diameter and mass of the above-ground part, which were recorded in variant with intensive irrigation, and the lowest ones were recorded in variant with the natural moisture variant (Fig. 1).

In the plant development process from the second sowing period, a gradual increase in plant height and diameter was also noted up to the mass flowering phase. Plants from the second sowing period at the mass flowering phase had a height ranging from 45 to 47 cm, with a diameter ranging from 37 to 45 cm (Fig. 2). Above-ground mass indicators ranged from 61 to 89 g per plant (Fig. 3). The highest indicators for the second sowing period were also obtained by plants that received intensive soil irrigation, and the lowest ones were obtained by natural moistening. When analyzing the influence of two sowing periods and three moistening options on the yield of above-ground mass of *Satureja hortensis* L., the highest indicators were obtained for variant with the first sowing period and intensive drip irrigation, and the lowest oner were obtained for variant with the second sowing period and natural moistening.

We conducted studies of the dynamics of essential oil accumulation at the phases of plant development depending on the intensity of drip irrigation and natural humidification. In the scientific literature, there is data on the positive effect of irrigation on the yield of essential oil from plants, which were obtained in other regions [3,13]. According to our studies, during the growing season, the content of essential oil in the vegetable raw materials of *Satureja hortensis* L. gradually increased in all variants of the experiment.

The mass fraction of essential oil at the mass flowering phase varied from 0.14 to 0.67%. In the first sowing period, this indicator was higher in the natural moisture variant, and the lowest one was in the intensive drip irrigation variant. The yield of essential oil from one plant was the highest in moderate drip irrigation and amounted to 0.55 g.

At the second sowing period, the mass fraction of essential oil was somewhat higher in moderate drip irrigation than in natural moisture and amounted to 0.55% of the fresh weight. This is explained by the fact that the plants of the second

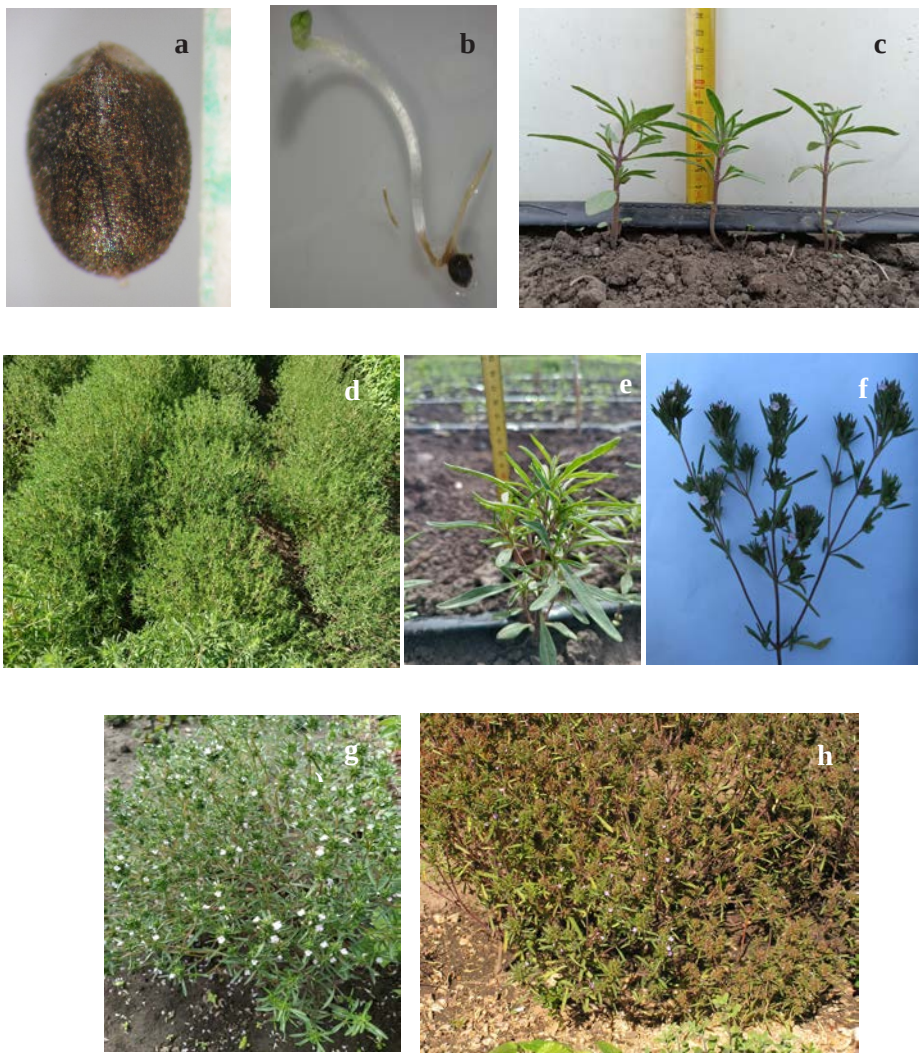

Fig. 1. Development phases of *Satureja hortensis* L.: a – seed; b – seed germination; c – stem growth in height; d – tillering; d – budding; e – beginning of flowering; e – mass flowering; g – fruiting

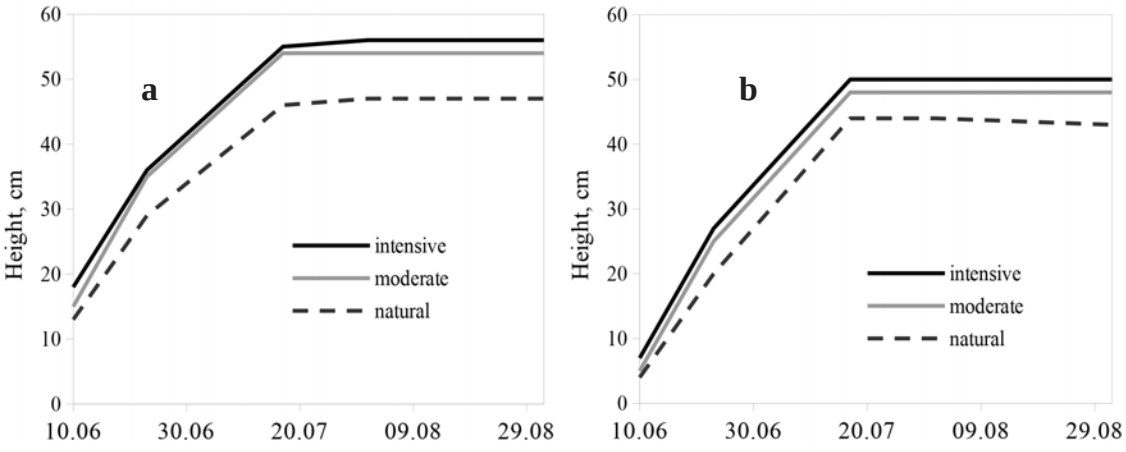

Fig. 2. Growth dynamics of *Satureja hortensis* L. plants depending on irrigation (intensive irrigation, moderate irrigation, natural moistening) and sowing dates i n the conditions of the Central Forest-Steppe: a – first sowing date, b – second sowing date

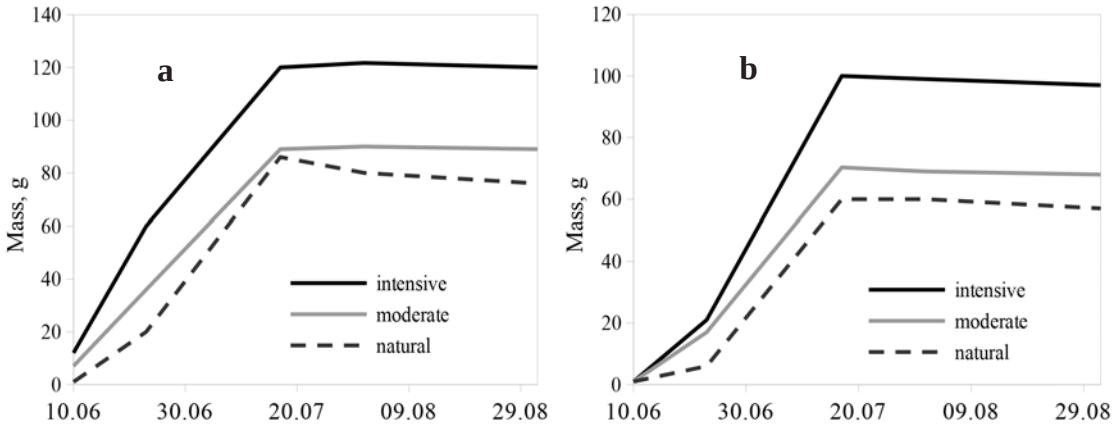

Fig. 3. Dynamics of above-ground mass accumulation in *Satureja hortensis* L. plants depending on irrigation (intensive irrigation, moderate irrigation, natural moistening) and sowing dates in the conditions of the Central Forest-Steppe a – first sowing date, b – second sowing date

sowing period under natural moisture conditions were less leafy, and in the shoots, as is known, a smaller amount of essential oil is synthesized, compared to the leaves and they are only ballast. The yield of essential oil from one plant in the second sowing period was also higher in the moderate moisture variant and amounted to 0.42 g.

Conclusions. Thus, taking into account two sowing dates and different options for moistening, we have established that in the conditions of the Central Forest-Steppe, *Satureja hortensis* L. plants in the first sowing date and intensive drip irrigation have the highest height and diameter indicators and form the highest yield of above-ground mass. Plants of the second sowing date and natural moistening have the lowest yield. The maximum indicators of the mass fraction of essential oil were recorded in plants in variant with the first sowing date and with natural moistening. However, the yield of essential oil from one plant, that is, plant productivity, was maximum in the variant with first sowing date and with moderate drip irrigation.

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Svydenko A.V., Valentiuk N.O., Svydenko L.V. Formation of economic valuable indicators in *Satureja Hortensis* L. depending on growing agrotechnical methods in the conditions of the Central Forest-Steppe

Purpose. The purpose of the work is to study the dynamics of growth and development, the formation of economically valuable traits of *Satureja hortensis* L. depending on the timing of sowing and moisture conditions in the Central Forest-Steppe. **Methods.** The research was conducted in 2024 in the conditions of the Central Forest-Steppe. The soil of the area where the research was conducted is typical black soil. The material for the research was a sample of *Satureja hortensis* L. No. 6-23. The seeds of this sample were sown in two rows with a row spacing of 50 cm. The first sowing period was carried out in the third decade of April. A decade later, the second sowing period was carried out. Crop irrigation was carried out in three variants, which included intensive drip irrigation, moderate drip irrigation and natural moistening. Phenological observations and biometric measurements were carried out for the crops. Every two weeks, the height and diameter of the plants were measured, the mass of the above-ground part of the plants was determined. The mass fraction of essential oil in the plant raw materials was determined by the Ginsberg method on the Clevenger apparatus. **Results**. The duration of the development phases of *Satureja hortensis* L. plants differed depending on the sowing dates. The tillering phase occurred for plants of the second sowing date three days later than for the first sowing date. The beginning of the budding phase was observed 44 days after the beginning of the tillering phase for plants from the first sowing date and 32 days later for plants from the second sowing date. The duration of the interphase period from budding to the beginning of flowering for plants from the first sowing date was 13 days, and for plants from the second sowing date it was 5 days shorter. Flowering of plants from the second sowing date also occurred in a shorter period. In the process of plant development, a gradual increase in the height and diameter of plants was noted. At the mass flowering phase, plants from the first sowing date were 45 to 57 cm high, with a diameter of 40 to 52 cm. At the same time, the above-ground mass indicators ranged from 62 to 121.7 g per plant. During the second sowing period at the mass flowering phase, the plants had a height ranging from 45 to 47 cm, with a diameter of 37 to 45 cm. The above-ground mass indicators ranged from 61 to 89 g per plant. The highest indicators of height, diameter and mass of the above-ground part were recorded for variant with intensive irrigation during the first sowing period, and the lowest ones were recorded for the natural moistening variant of the second sowing period. During the growing season, the content of essential oil in the vegetable raw materials of *Satureja hortensis* L. gradually increased in all variants of the experiment. The mass fraction of essential oil at the mass flowering phase varied from 0.14 to 0.67%. The highest mass fraction of essential oil was observed for plants in variant with the first sowing period and with natural humidification. And the yield of essential oil from one plant was maximum for variant with the first sowing date and with moderate drip irrigation (0.55 g). **Conclusions.** Thus, in the conditions of the Central Forest-Steppe, *Satureja hortensis* L. plants from the first sowing period and with intensive drip irrigation have the highest height and diameter indicators and form the highest yield of above-ground mass. The maximum indicators of the mass fraction of essential oil were recorded in plants from the first sowing period with natural moisture. However, the yield of essential oil from one plant, that is, plant productivity, was maximum in variant with the first sowing period with moderate drip irrigation.

Key words: *Satureja hortensis* L., development phases, yield, essential oil, irrigation.

Свиденко А.В., Валентюк Н.О., Свиденко Л.В. Формування господарсько цінних показників *Satureja hortensis* L. в умовах Центрального Лісостепу в залежності від агротехнічних прийомів вирощування.

Мета. Метою роботи є вивчення динаміки росту та розвитку, формування господарсько цінних ознак чабера садового залежно від строків сівби та умов зволоження в умовах Центрального Лісостепу. **Методи.** Дослідження проводились в 2024 році в умовах Центрального Лісостепу. Грунт ділянки, на якій проводились дослідження типовий чорнозем. Матеріалом для досліджень слугував зразок чабера садового № 6-23. Насіння даного зразка висівали в два строки з шириною міжрядь 50 см. Перший строк сівби проводили в третій декаді квітня. Через декаду проводили другий строк сівби. Зволоження посівів проводилося в трьох варіантах, яке включало інтенсивне крапельне зрошення,

помірне крапельне зрошення та природне зволоження. За посівами проводились фенологічні спостереження та біометричні вимірювання. Через кожні два тижні вимірювали висоту та діаметр рослин, визначали масу надземної частини рослин. Масову частку ефірної олії в рослинній сировині визначали методом Гінсберга на апараті Клевенжера. **Результати**. Тривалість фаз розвитку рослин чабера садового відрізнялись в залежності від строків сівби. Фаза кущіння настала у рослин другого строку посіву через менший термін, ніж за першого строку на три дні. Початок фази бутонізації спостерігали через 44 дні від початку фази кущіння у рослин за першого строку сівби та через 32 дні у рослин за другого строку сівби. Тривалість міжфазного періоду від бутонізації до початку цвітіння у рослин за першого строку сівби становила 13 днів, а у рослин за другого строку сівби вона була коротшою на 5 днів. Цвітіння рослин за другого строку сівби настало також за коротший термін. В процесі розвитку рослин відмічено поступове збільшення висоти та діаметра рослин. У фазі масового цвітіння рослини за першого строку сівби були заввишки від 45 до 57 см, при діаметрі від 40 до 52 см. При цьому показники надземної маси коливались від 62 до 121,7 г з однієї рослини. За другого строку сівби у фазі масового цвітіння рослини мали висоту, яка коливалась від 45 до 47 см, при діаметрі від 37 до 45 см. Показники надземної маси коливались від 61 до 89 г з однієї рослини. Найвищі показники висоти, діаметра та маси надземної частини зафіксовані за інтенсивного зрошення за першого строку сівби, а найменші у варіанті природного зволоження другого строку сівби. Протягом вегетації вміст ефірної олії в рослинній сировині чабера садового поступово збільшувався у всіх варіантах досліду. Масова частка ефірної олії у фазі масового цвітіння варіювала від 0,14 до 0,67% від сирої маси. Найвищі показники масова частки ефірної олії мали рослини за першого строку сівби та природного зволоження. А вихід ефірної олії з однієї рослини був максимальним за першого строку сівби та помірного крапельного зрошення (0,55 г). **Висновки.** Таким чином, в умовах Центрального Лісостепу рослини чабера садового за першого строку сівби та інтенсивного крапельного зрошення мають найбільші показники висоти та діаметра і формують найбільшу урожайність надземної маси. Максимальні показники масової частки ефірної олії зафіксовано у рослин за першого строку сівби з природним зволоженням. Проте вихід ефірної олії з однієї рослини, тобто продуктивність рослин, була максимальною при першому строкові сівби за помірного крапельного зрошення.

Ключові слова: *Satureja hortensis* L., фази розвитку, урожайність, ефірна олія, зрошення.