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Assessment of growth and development of cowpea varieties based on phenological and morphological observations

Abstract. The search and selection of cowpea varieties with optimal economic characteristics is a key factor in the development of cultivation technologies to increase yields. The purpose of the study was to determine the phenological and morphological characteristics of cowpea varieties and establish the relationship between economically valuable indicators and weather conditions. The leading approaches to studying this problem are field method – to assess the growth and development of cowpea varieties; statistical – to conduct variance and correlation analysis of the assessment of morphological features and economically valuable indicators of cowpea. Five cowpea varieties were studied: Groik (Israel), Kafedralna (Ukraine), Gasson (Vietnam), American improved (USA), and U-Cha-Kontou (China). It was found that the duration of phenological phases of cowpea varieties depended on weather conditions. Varieties of cowpea were characterised by early maturation periods for the sum of effective temperatures of 192.0-207.5°C and precipitation of 30.54-31.65 mm. Earlier maturation periods were the varieties American improved, Kafedralna, Gasson with the duration of the period from germination to the beginning of harvesting ripeness of the pod – 58-62 days and the duration of the period from germination to biological ripeness of seeds – 92-94 days. For the vegetable industry, bush varieties Kafedralna and U-Cha-Kontou with a plant height of 48.5-54.9 cm were promising, which formed tender long beans with a weak parchment layer (22.8-23.6 cm). Groik and Gasson varieties proved valuable for growing seedlings due to the small light-coloured seeds with a plant height of 61.8-100.5 cm and the formation of a large number of short beans on the plant (12.8-15.6 cm). A strong relationship between morphological features and economically valuable indicators of cowpea has been established. The average bean yield had a direct strong relationship with the total number of beans per plant (r=0.93) and a strong inverse relationship with the length of the bean (r=-0.88). As the length of the beans increased, the average yield of beans and the number of beans on the plant decreased, as evidenced by a strong inverse relationship between these indicators (r=-0.93). The materials of the paper are of practical value for increasing the species diversity of vegetable crops and improving the provision of valuable food products to the population

Keywords: legumes, bean pods, flowering, harvesting ripeness, plant height, bean length, seeds

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INTRODUCTION

Vegetable growing in Ukraine has become a highly developed industry, the main task of which is to provide the population with food. It is necessary to introduce new technologies to intensify production. In turn, the criterion for evaluating any crop cultivation technology remains the yield, and its value must be economically justified and energetically confirmed. Along with the growth of yields, there is a constant expansion of vegetable diversity based on Ukraine's own production and imports. Among them, legumes are very valuable (Bobos et al., 2022).

In the vegetable growing industry of Ukraine for 2022, only a small number of species from the legume family are grown (Fabaceae) (Bobos et al., 2022). These are mainly vegetable beans, vegetable peas and, very rarely, vegetable beans. Even among these species, producers have not yet fully used them for the vegetable industry, including for obtaining unripe seeds, for green beans-pods, etc. The world variety of cultivated vegetable legumes is very large and includes more than 40 species. Vegetable farmers grow quite a lot of types – kidney and lima beans, sugar peas, dolichos, tetragonolobus, vegetable bean, trigonella (fenugreek, mushroom grass), cowpea, etc. (Bobos et al., 2022).

In Ukraine, domestic varieties have not yet been created for these species, and amateur vegetable growers widely grow local and accidentally introduced forms. Almost all crops have not developed technologies for their cultivation, both for one-time harvesting and for creating continuous production for a long period in supermarkets (Sysh & Bobos, 2011).

One of the most promising low-spread legumes is cowpea, which is valued for its content of easily accessible protein and vitamins, and also accumulates all the amino acids, calcium, phosphorus, and iron salts necessary for humans.

Morphological features of cowpea are very similar to beans. Genus Vigna (Vigna sp.) is characterised by a wide variety, which is collected at the International Institute of Tropical Agriculture of Nigeria (Sysh & Bobos, 2011). The State register of plant varieties has already included the first new climbing variety Kherson, which was created at the Institute of Southern Vegetable and Melon Production of the National Academy of Agrarian Sciences of Ukraine. In the steppe and forest-steppe of Ukraine, there is a sufficient sum of effective temperatures for growing cowpea (Sysh & Bobos, 2011).

Cowpea is grown to produce ripe seeds, green pods, and unripe "flageolet" seeds. In the United States, high-quality seedlings are obtained from the seeds of small-seeded varieties (Barros et al., 2021).

The optimal time for harvesting young beans on the cowpea pods falls on Day 7-10 after pollination. Especially valuable are varieties with black seeds that do not accumulate heavy metals – cadmium and lead.

At the Department of Indoor Vegetable Growing of the National University of Life and Environmental Sciences of Ukraine for the first time in the northern forest-steppe during 2008-2010, samples of cowpea varieties were studied and evaluated, and their comparative assessment was carried out by precocity, morphological characteristics, productivity (Sysh & Bobos, 2011; Bobos et al., 2022). Valuable source material of cowpea was identified, which was used in breeding work as parent forms and the first bush plant of the Kafedralna variety was created. At the same time, there was a need for a comparative assessment of cowpea varieties by phenological and morphological characteristics, considering changes in climatic conditions.

The main value of cowpea is its high drought, heat, and salt resistance, which allows growing this crop for seeds, green manure, feed, and vegetables (Sysh & Bobos, 2011; Barros, 2021). However, an increase in temperature is associated with accelerated growth and the duration of the phenological phases of the crop. Once in stressful conditions, plants change their metabolism so as not to disrupt their normal development. Acceleration of development occurs due to the plant's response to stress, increased respiration (Schmidt et al., 2017). In this context, studying how cowpea plants respond to increased water scarcity and rising air temperatures, in the long run, can help growers change their management practices to maintain sustainable production (Barros, 2021).

Cowpea can grow and develop in a wide temperature range, from 18 to 37°C, but the optimal temperature value varies depending on the phenological stage of the plant. Temperatures above 35°C cause abortivity of flowers, stimulates the ageing of leaves, reducing photosynthetic ability, which affects the productivity of beans and cowpea seeds, since such an increase disrupts the physiological and biochemical processes in plants (Zandalins et al., 2018). In response, plants reduce the chlorophyll content, photosynthetic rate, and transpiration rate in an attempt to reduce moisture loss (Taiz et al., 2017).

Climate change is becoming a challenge for food security, as rising temperatures and changes in precipitation distribution have a negative impact on agricultural production (Gomes et al., 2019). In addition, forecasts for the future indicate that water scarcity can significantly affect plant growth and development on more than 50% of agricultural land by 2050, which would reduce crop yields worldwide (Deryng et al., 2011; Hasanuzzaman, 2019). Despite the fact that the main abiotic factor affecting the water balance of plants is a lack of soil moisture, the severity of this effect largely depends on air temperature (Jumrani & Bhatia, 2018; Havryliuk et al., 2022).

Numerous studies have shown that climate change has adverse effects on food production and food security, and the adverse effects are projected to increase in the future (Hansen, 2011; Iizumi et al., 2014). Climate variability, such as being too wet or too dry, also affects yields (Iizumi & Ramankutty, 2015).

Thus, the analysis of literature sources indicates the influence of climatic conditions on the economically valuable indicators of cowpea and the need to study the variability of phenological and morphological features of crop varieties for the introduction of adaptive to growing conditions in production.

Purpose of the study is to determine the phenological and morphological characteristics of cowpea varieties and establish the relationship between economically valuable indicators and weather conditions.

MATERIALS AND METHODS

During 2014-2016, 5 varieties of cowpea were studied: Groik (Israel), Kafedralna (Ukraine), Gasson (Vietnam), American improved (USA), and U-Cha-Kontou (China). The research was conducted on the collection sites of the Department of Indoor Vegetable Growing in the Training Lab "Fruit and Vegetable Garden" of the National University of Life and Environmental Sciences of Ukraine, which is located in the northern part of the forest-steppe of Ukraine on sod-medium podzolic soils. The field method was performed according to one-factor experiment scheme (Bondarenko & Yakovenko, 2001). Repeatability – three times with randomisation. The accounting area – 5 m^2. The promising Ukrainian variety Kafedralna was taken as control.

Cowpea cultivation techniques are similar to those used for vegetable beans in production (Sysh, 2011). The sowing scheme was 70×25 cm. Seed embedding depth – 2-3 cm.

Seeds of the varieties under study and control were sown simultaneously on May 13. Immediately after sowing, the rows were mulched and the soil between the rows was loosened. Plant care consisted of systematic loosening, and control of weeds, diseases, and pests.

During the field experiments, the following phenological phases were noted: full shoots, the beginning and full flowering, the beginning of harvesting ripeness of pods and the economic ripeness of beans. Shoots were noted by the appearance of cotyledons on the surface (Bondarenko & Yakovenko, 2001). In cowpea, the beginning of maturation was noted by the maturation of the predominant number of beans. The duration of the growing season was calculated from the date of sowing to economic ripeness. The sowing-germination period for selected varieties ranged from 12 to 17 days and took place with an average sum of effective temperatures of 70.2-105.7°C and precipitation of 42.8-56.8 mm.

Harvesting was carried out on all variants of the experiment simultaneously with the onset of the economic ripeness of beans – on September 6. Before harvesting, biometric measurements were made, namely, the length of the central stem was measured with a ruler and the number of side shoots on the plants was counted. During harvesting, the number and weight of beans per plant, the length of the bean, and the number of seeds per bean were determined. Simultaneously considering the yield, an average sample was selected from all varieties according to the variants, which was used to determine the weight of 1,000 seeds.

Variance (ANOVA) and correlation analysis were performed using the XLSTAT add-in in MS Excel software suite. The differences were considered significant for the validity of α=0.95 (Nageswara, 2018).

RESULTS AND DISCUSSION

The study of phenological variability showed that cowpea varieties were characterised by early maturation periods. Earlier flowering was noted in the varieties Kafedralna, Gasson, and U-Cha-Kontou, with the beginning of flowering on 13.07. Late flowering dates were characterised by the Groik variety (16.07), which affected the beginning of harvesting ripeness of the pods, which was noted later than other varieties 02.08. The variability of plant growth and development affected the duration of phenological phases of cowpea varieties (Fig. 1).

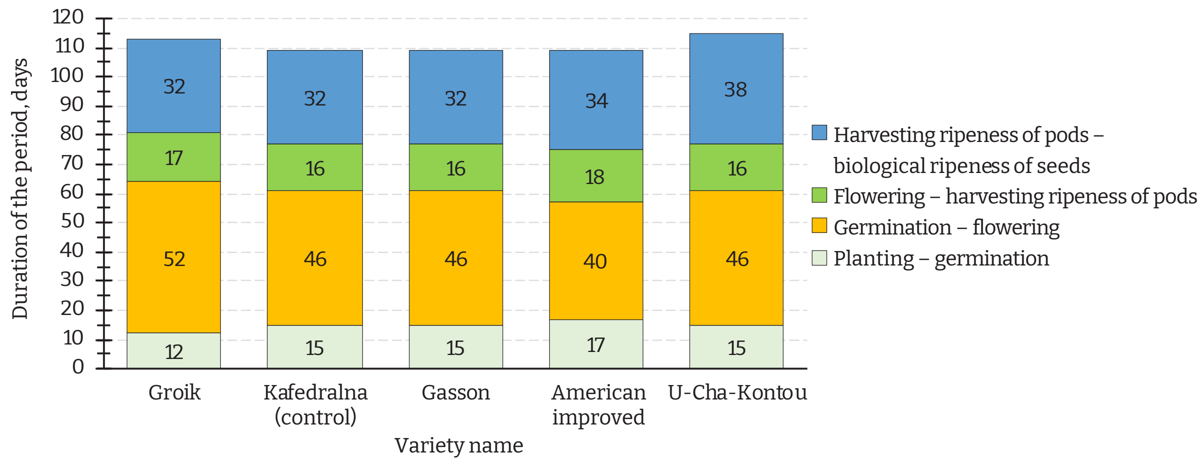

Figure 1. Duration of phenological phases of cowpea varieties, days (average for 2014-2016)

The shortest period from germination to flowering was distinguished by the American improved variety (Day 40), the longest period was observed in such varieties as Groik (Day 52) and Gasson (Day 46). This period was held at an average sum of effective temperatures of 436.6-549.7°C and precipitation of 45.83-68.28 mm (Fig. 2, 3)

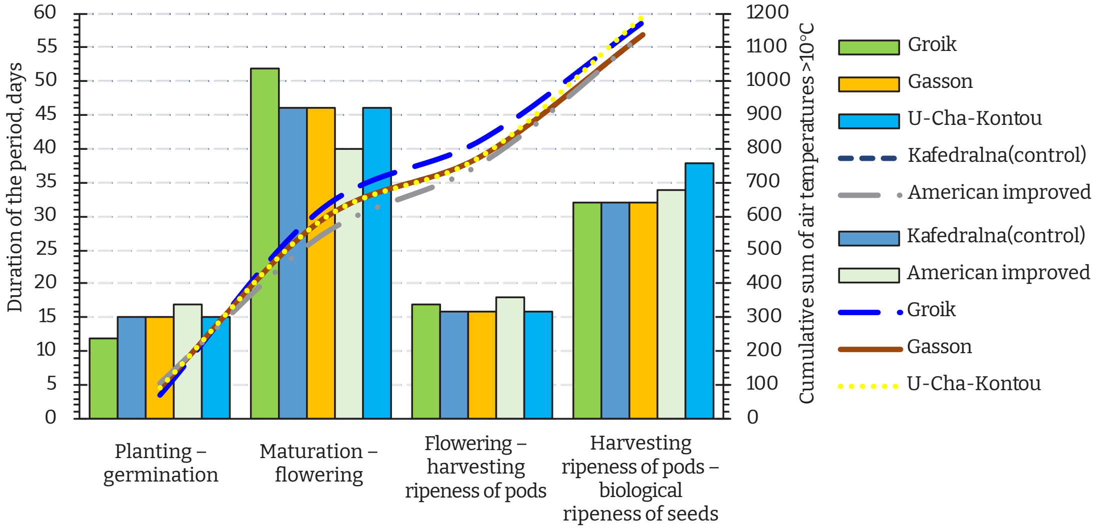

Figure 2. Influence of the sum of air temperatures over 10°C on the passage of phenological phases in cowpea varieties

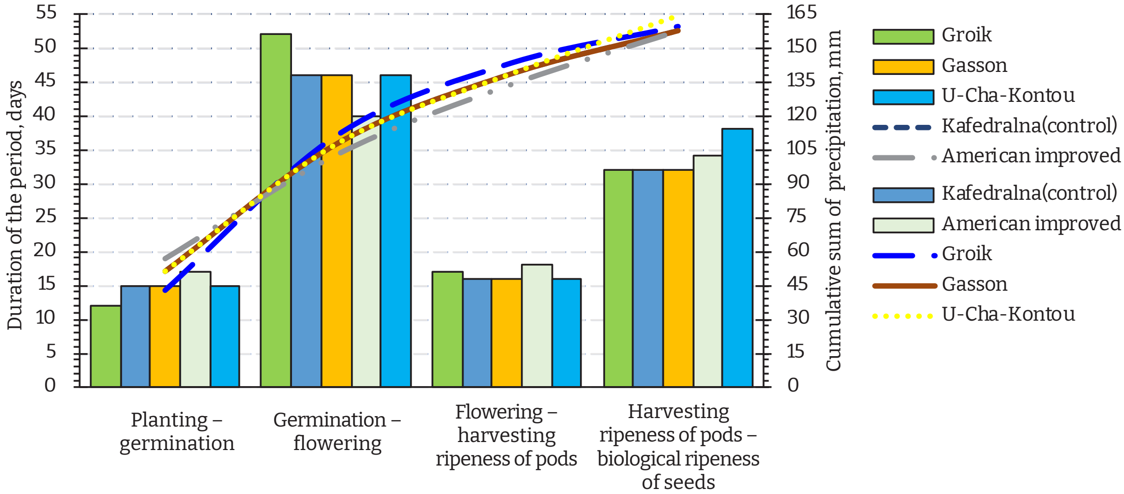

Figure 3. Influence of precipitation amount on the passage of phenological phases in cowpea varieties

The period from flowering to the beginning of harvesting ripeness of the pods was almost the same in all varieties and ranged from 16 to 18 days. The average sum of effective temperatures during this period was 192.0-207.5°C and the amount of precipitation was 30.54-31.65 mm. But it is the smallest in the control varieties Kafedralna, U-Cha-Kontou, and Gasson (16 days).

The period from germination to the beginning of harvesting ripeness of the pods was the smallest in the American improved variety (58 days), which characterises the variety with an early maturation period. This period took place with an average effective amount of 652.1°C and a precipitation amount of 76.4 mm. The longest period was observed in the Groik variety – 69 days.

Kafedralna, American improved, and Gasson varieties with a duration of 92-94 days from germination to biological ripeness of seeds distinguished themselves by their early maturation periods. The average sum of effective temperatures during this period was 1,034.6-1,047.0°C and the sum of precipitation was 100.7-106.4 mm. The duration of the period from germination to biological ripeness of seeds in the Groik and U-Cha-Kontou varieties was 100-101 days, which indicates their average maturation time. This period was held at an average effective amount of 1,100.7-1,105.3°C and precipitation of 113.0-116.0 mm.

Cowpea varieties differed in morphological characteristics from each other (Table 1). Among the cowpea assortment that was tested, dwarf bush varieties with plant heights up to 50 cm and more than 50 cm are distinguished. Among the dwarf varieties, Kafedralna and American improved stand out. The average height of plants of these varieties reached 46.1-48.5 cm. Groik and Gasson varieties were characterised by intensive growth of the main and lateral shoots, due to which they can be grown on supports. The height of these varieties was 61.8-100.5 cm with the shortest length of beans – 12.8-15.6 cm. These varieties formed a large number of beans on the plant (34.6-58.3 pcs.), which affected their seed productivity.

Table 1. Evaluation of cowpea varieties by morphological parameters

Variety name	Plant height, cm				Number of beans per plant, pcs.				Bean length, cm			
	years			Average	years			Average	years			Average
	2014	2015	2016		2014	2015	2016		2014	2015	2016	
Groik	98.7	96.4	106.4	100.5	34.2	36.2	33.4	34.6	15.2	16.5	15.1	15.6
Kafedralna (control)	50.1	47.3	48.1	48.5	24.7	26.1	24.8	25.2	24.5	23.1	23.2	23.6
Gasson	60.9	58.9	65.6	61.8	57.9	60.1	56.9	58.3	13.1	12.5	12.8	12.8
American improved	47.2	45.2	45.9	46.1	13.1	12.5	12.5	12.7	27.2	26.4	25.9	26.5
U-Cha-Kontou	53.8	55.6	55.3	54.9	16.1	15.5	16.1	15.9	23.1	20.4	24.3	22.8
LSD_{05}				5.36				1.93				1.59

Source: based on the conducted research

The main feature of pods is the absence of a parchment layer and fibres in the seams. The best quality vegetable varieties are those in which the beans do not thicken for a long time and are not characterised by a tendency to form a parchment layer and fibre during the entire harvesting period. Kafedralna and U-Cha-Kontou varieties were characterised by a plant height of 48.5-54.9 cm. In the Kafedralna variety, a larger number of beans were formed on the plant (25.2 pcs.) with strong peduncles and long beans (23.6 cm) (Fig. 4). They are characterised by the establishment of a weak parchment layer and fibre, especially in conditions of high air temperature and delayed harvesting. However, the disadvantage of the Kafedralna and U-Cha-Kontou varieties is that the long beans (22.8-23.6 cm), which are laid on the soil, are polluted and therefore require mulching with straw. At the same time, the U-Cha-Kontou variety formed a small number of beans on the plant (15.9 pcs.) with a small number of seeds, which affected the low seed productivity of plants.

Figure 4. Kafedralna beans

A small number of beans on the plant was also established by the American improved variety, which on average for three years revealed the smallest plant height of 46.1 cm with fewer beans on the plant (12.7 pcs.) and a longer bean length (26.5 cm), which affected the productivity of plant seeds.

Groik and Gasson varieties belong to cereals. Their height is more than 50 cm. The beans are short with a well-defined parchment layer, which makes it impossible to use them to produce unripe pods. At the same time, these varieties are very valuable for growing seedlings due to the small light-coloured seeds. Semi-bush cowpea varieties Gasson and Groik do not need supports. Despite the high ability to form a large number of lateral shoots, they form a crop on strong vertical peduncles.

Using correlation calculations, the relationship between morphological features and economically valuable indicators of cowpea is established (Table 2).

Calculation of the correlation coefficient showed that the average bean yield has a direct strong relationship with the total number of beans per plant (r=0.93) and a strong inverse relationship with the bean length (r=-0.88). As the length of the beans increased, the average bean yield decreased. At the same time, as the bean length increased, the number of beans decreased, as evidenced by a strong inverse relationship between these indicators (r=-0.93).

In this study, the productivity of ripe seeds of a single plant has a strong direct relationship with the number of beans per plant (r=0.96) and the average yield over three years (r=0.91) and the inverse strong relationship with bean length (r=-0.79). There is a clear pattern: varieties with a longer bean length produce fewer seeds, which affected the lower productivity of ripe seeds. The same pattern exists for the yield of ripe seeds, which has a strong direct relationship with the number of beans on the plant (r=0.96), the average yield over three years (r=0.91), and the length of the bean (r=-0.78).

Table 2. Matrix of correlations between morphological features and economically valuable indicators of cowpea

Indicator	Plant height, cm	Number of beans per plant, pcs.	Bean length, cm	Average bean yield for three years, t/ha	Number of seeds in a bean, pcs.	Productivity of ripe seeds per one plant, g	Yield of ripe seeds, t/ha	Weight of 1,000 seeds, g
Plant height, cm	1							
Number of beans per plant, pcs.	0.38	1						
Bean length, cm	-0.66	-0.93	1					
Average bean yield for three years, t/ha	0.46	0.93	-0.88	1				
Number of seeds in a bean, pcs.	-0.25	0.18	0.00	-0.06	1			
Productivity of ripe seeds per one plant, g	0.14	0.96	-0.79	0.91	0.26	1		
Yield of ripe seeds, t/ha	0.13	0.96	-0.78	0.91	0.26	1.00	1	
Weight of 1,000 seeds, g	-0.82	-0.82	0.96	-0.77	-0.04	-0.63	-0.63	1

Source: based on the conducted research

In addition, a direct strong relationship was established between the weight of 1,000 seeds and the length of the bean (r=0.96) and an inverse relationship with the height of plants (r=-0.82), the number of beans per plant (r=-0.82), and the average yield of beans (r=-0.77).

Significant differences were found between the weight of 1,000 seeds and the length of the bean (r=0.96) and the productivity of ripe seeds of one plant with the number of beans per plant (r=0.96).

The results of the study show that abiotic factors play a very important role in the growth and development of cowpea. The results of the analysis of agrometeorological conditions during cowpea cultivation indicate that the duration of interphase periods depends on environmental factors such as heat and moisture. As a general pattern, it can be noted that at the beginning of the growing season of the studied crop, the rate of onset of development phases is significantly affected by the amount of precipitation. Knowledge of the duration of the growing season is necessary primarily to get an idea of the early ripening of the variety and establish the possibility of its cultivation in a particular soil and climatic zone.

Research conducted by J.L. Hatfeld and J.H. Prueger (2015) also shows that plant growth and development depend on temperature and that each variety has a characteristic temperature range expressed by minimum, maximum, and optimum. According to L.F. Oliveira (2018) individual phenological phases, such as flowering and formation of cowpea beans, largely depend on the availability of soil moisture. In addition, temperatures outside the optimal value can affect seed germination up to the final stage of development (Sehgal et al., 2018). For cowpea, the reproductive stage is most sensitive to rising temperatures, which leads to the loss of flower buds and beans, and reduces seed productivity (Singh et al., 2010). Therefore, the selection of tolerant varieties in this context will be crucial to minimise losses due to climate change (Barros et al., 2021).

An increase in the temperature regime leads to an increase in vegetative development, since the optimal temperature for vegetative development is higher than the optimal temperature for reproductive development (Hatfeld & Prueger, 2015). Leaves adapt to high temperatures due to effective thermal resistance mechanisms that allow leaf temperature control through transpiration during periods with elevated temperatures (Sehgal et al., 2018). Plants tend to channel their resources to overcome heat stress by limiting photosynthesis, which is essential for reproductive development. Therefore, exposure to high temperatures on plants during the grain development phase, even for a short period, can accelerate leaf ageing, reduce the number and weight of seeds, and reduce crop yields (Sita et al., 2018). In addition, the root system is more sensitive to the stress effects of high temperatures than the aboveground part of plants, as indicated by an increase in the ratio of vegetative mass to roots (Barros et al., 2021).

The weight of 100 seeds is one of the most important marketing characteristics, since the heavier the seeds, the higher the price for them. During processing, the weight of seeds is also important information for designing appropriate processing machines that can process the maximum weight of seeds (Gondwe et al., 2019). Seed size in cowpea plays a key role, because it directly indicates the yield of the variety and, together with colour standardisation, determines the corresponding grain quality (Gunathilake et al., 2016). Seed size also reflects seed quality indicators, and therefore, plant growth is affected by the size of the seed that was sown (Ambika et al., 2014). Under appropriate conditions, germination and subsequent growth of varieties with large seeds will definitely provide more seedlings compared to small seeds, which may contribute to increased crop productivity (Krisnawati et al., 2015).

Protein accumulation in cowpea increases significantly from 10 to 20 days after flowering and the maximum content is observed during the period of full ripeness, as a result, farmers often cannot recognise the phase of increasing nitrogen content in cowpea seeds for better protein intake. Ishikawa et al. (2021) note that to increase protein intake from green beans, a visual method has been developed to determine bean elongation, namely, the relative length of beans, which allows estimating the nitrogen content of unripe seeds. This is a simple visual method for determining the optimal time to harvest green beans and is therefore very practical for farmers.

There are morphological differences between grain cowpea and spearhead in terms of bean characteristics, including bean length, bean tenderness, bean cracking, and the presence of fibres in the bean (Suanum et al., 2016).

Correlation analysis is an important tool for determining relationships between plant traits, but correlation coefficients can be misleading if the correlation between two traits is the result of indirect exposure to other traits (Bizeti et al., 2004).

Undensi et al. (2012) recorded a significant positive correlation between flowering and bean maturation in some cowpea varieties and concluded that there is a strong association between the plant growth period before flowering and the time of bean or seed development. The early start of flowering and ripening of beans is crucial for increasing yields in regions with a short period of moisture. Delayed flowering and maturation of beans can prevent the formation of proper quality beans and seeds in cowpea (Aliyu et al., 2022). Watcharatpong et al. (2020) note that the fibre content (cellulose, lignin, and haemicellulose) correlates with the tenderness (softness/hardness) and cracking of beans.

Important factors affecting cowpea yield are the number of beans per plant and the number of seeds in them (Srinivas et al., 2017).

Aliyu et al. (2019) indicate that a strong inverse relationship has been established between phenological traits and yield components.

Among the quantitative agronomic features associated with cowpea yield is bean length (Ogunkanmi et al., 2013).

The results obtained in this study show that high temperatures affect the metabolism of cowpea plants, causing changes in plant growth. However, the varieties had different physiological responses due to each variety's different need for thermal energy. Therefore, the selection of varieties that are resistant to high temperatures is an important measure. However, the influence of temperature combined with a lack of moisture can be more harmful, so it is necessary to understand the interaction of temperature and moisture in different varieties of cowpea to develop effective strategies for adapting cultivation technology.

CONCLUSIONS

Early maturation periods are characterised by the varieties American improved, Kafedralna, Gasson with the duration of the period from germination to the beginning of harvesting ripeness of the pod – 58-62 days and the duration of the period from germination to biological ripeness of seeds – 92-94 days. For the vegetable industry, bush varieties Kafedralna and U-Cha-Kontou with a plant height of 48.5-54.9 cm are promising, forming tender long beans with a weak parchment layer (22.8-23.6 cm). Groik and Gasson varieties are valuable for growing seedlings due to their small light-coloured seeds with a plant height of 61.8-100.5 cm and the formation of a large number of short beans on the plant (12.8-15.6 cm). The relationship between morphological features and indicators of the economic value of cowpea was revealed. The average bean yield had a direct strong relationship with the total number of beans per plant (r=0.93) and a strong feedback with the length of the bean (r=-0.88). The average yield of beans and the number of beans per plant decreased with increasing bean length, as evidenced by a strong inverse relationship between these indicators (r=-0.93).

Promising areas for research are the isolation and selection of cowpea genotypes with the desired agronomic properties for inclusion in future breeding programmes aimed at genetically improving seed yield.

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Оцінка росту та розвитку сортів вігни за фенологічними і морфологічними спостереженнями

Анотація. Пошук та відбір сортів вігни з оптимальними господарськими ознаками є ключовим фактором у розробці технологій вирощування для підвищення рівня врожайності. Мета досліджень полягала у визначенні фенологічних і морфологічних ознак сортів вігни кущової та встановленні взаємозв'язку між господарсько-цінними показниками та погодними умовами. Провідними методами дослідження цієї проблеми є польовий – для оцінки росту та розвитку сортів вігни, статистичний – для проведення дисперсійного та кореляційного аналізу оцінювання морфологічних ознак та господарсько-цінних показників вігни. Вивчено п'ять сортів кущової вігни: Гроік (Ізраїль), Кафедральна (Україна), Гассон (В'єтнам), Американська покращена (США), У-Тя-Контоу (Китай). З'ясовано, що тривалість фенологічних фаз сортів вігни залежала від погодних умов. Сорти вігни кущової характеризувались ранніми строками достигання за суми ефективних температур 192,0-207,5 °С і суми опадів 30,54-31,65 мм. Більш ранніми строками достигання виявилися сорти Американська покращена, Кафедральна, Гассон з тривалістю періоду від сходів до початку збиральної стиглості лопатки 58-62 діб і тривалістю періоду від сходів до біологічної стиглості насіння – 92-94 доби. Для овочевого напряму перспективними виявилися кущові сорти Кафедральна та У-тя-Контоу з висотою рослин 48,5-54,9 см, які формували ніжні довгі боби зі слабким пергаментним шаром (22,8-23,6 см). Сорти Гроік та Гассон виявилися цінними для вирощування проростків завдяки дрібному світло забарвленому насінню з висотою рослин 61,8-100,5 см та формуванням великої кількості коротких бобів на рослині (12,8-15,6 см). Встановлений сильний взаємозв'язок між морфологічними ознаками та господарсько-цінними показниками вігни. Середня врожайність бобів мала прямий сильний зв'язок із загальною кількістю бобів на рослині (r=0,93) та сильний обернений зв'язок із довжиною бобу (r=-0,88). Із збільшенням довжини бобів зменшувалась середня урожайність бобів і кількість бобів на рослині, про що свідчить сильний обернений зв'язок цих показників (r=-0,93). Матеріали статті становлять практичну цінність для збільшення видового різноманіття овочевих культур та покращення забезпечення населення цінними харчовими продуктами

Ключові слова: бобові культури, боби-лопатки, цвітіння, збиральна стиглість, висота рослин, довжина бобу, насіння