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Economic and biological evaluation of Chinese cabbage [*Brassica rapa* L. var. *pekinensis* (Lour.) Kitam.] hybrids grown in the Right-Bank Forest Steppe of Ukraine

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Purpose. To study the economic and biological characteristics and to reveal the genetic potential of various hybrids of Chinese cabbage depending on the climatic zone of cultivation. **Methods.** In the experiment, hybrids of Chinese cabbage 'Pioner F₁' (control), 'Villi F₁', 'Manoko F₁', 'Orient Star F₁', 'Vitimo F₁', 'Sprinkin F₁', 'Summer Highland F₁', 'Suprin F₁', and 'Richi F₁' were evaluated. The experiment was laid out in a randomized block design with four replications with a single plot area of 21 m². The container seedlings (40 days old) were planted in the middle of April according to the scheme 70 cm by 25 cm. **Results.** Having been planted at the same time, seed germination over the studied hybrids was not simultaneous. The first sprouted seeds (4 days after seeding) belonged to hybrids 'Villi F₁', 'Manoko F₁', 'Orient Star F₁', and 'Summer Highland F₁'. Seeds of the other hybrids started active germination on the 5–6 days after seeding. The highest yield of the cabbage heads was obtained from hybrids 'Villi F₁' (31.7 t/ha) and 'Sprinkin F₁' (28.7 t/ha), which was 10.0 and 7.0 t/ha more than in the control variant. The yield of 'Summer Highland F₁' was 24.9 t/ha and 'Suprin F₁' 24.6 t/ha. Under the conditions of unstable soil moisture, hybrids 'Villi F₁' and 'Sprinkin F₁' appeared the most productive and ensured yield increase of 10.0 t/ha and 7.0 t/ha, respectively, compared to the control; and crop commercial quality was high. The highest percentage of dry matter (DM) content was in 'Summer Highland F₁' (6.2%) followed by 'Sprinkin F₁' (5.9%), which was 1.1% and 0.8% more than in the control. There was no significant difference between the values of the total sugars content over the variants. They ranged between 1.7 and 2.1%, which was similar to the control values. The content of nitrates in the cabbage heads of the studied Chinese cabbage hybrids was within the tolerance limit and amounted to 600 mg/kg (raw mass). **Conclusions.** Phenological observations of plant development and their biometric indices, depending on the varietal characteristics, indicate that under the conditions of unstable soil moisture, hybrids 'Villi F₁' and 'Sprinkin F₁' were more yielding and ensured yield increase of 10.0 t/ha and 7.0 t/ha, respectively, compared to the control. The crop commercial quality was high. The long growing season of 'Richi F₁' (93 days) did not affect the crop quality and yield and demonstrated the lowest productivity compared to the control and the other experiment variants.

Keywords: cabbage head; biometric indicators; phenological observations; nitrate content, yield.

Introduction

Nowadays olericulture is aimed at providing the population with fresh vegetables. The need for them is far from being fully satisfied, there is a poor assortment of vegetables both in the public and in the individual sector, the seasonality of fresh produce, low productivity and

product quality and a low percentage of its sale [1]. Chinese cabbage, as an early-ripe crop, is becoming more and more popular with consumers every year and, accordingly, its cultivation areas are increasing. The growing demand for chinese cabbage is due to the growing culture of its consumption by the population and its unique chemical composition. Chinese cabbage has a low energy value – 125 kJ/100 g of product, and heads rich in sugar – 1.5–3.8%, starch – up to 0.4%, fiber – up to 0.7–1.2%, calcium – 0.95%, phosphorus – 1.16%, potassium – 0.36%, and sodium – 0.16% [2]. In a short period, the plant forms nutritionally valuable greens. 100 g of fresh produce contains up to 1 g

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of protein, 0.3 g of fat, 250 mg of potassium, 0.9–1.3 mg of iron. The refined taste and aroma of its fresh leaves stimulates appetite, increases the ability to assimilate [3, 4].

Fifteen years ago in Ukraine Chinese cabbage leafy varieties called lettuce, prevailed; now head forming varieties of foreign breeding are mainly grown, which brought the culture of its consumption to the level of white cabbage with high productivity and product quality [5]. When choosing a variety or hybrid, one should take into account its resistance to bolting, a suitable growing period, and head weight. A variety as a biological system determines the degree of use of environmental and technogenic resources. Therefore, breeding under market conditions should respond specifically to the needs of the time and be aimed at drought tolerance, adaptability, early maturity, quality and a high low-threshold for the productivity of vegetable raw materials [6, 7].

Chinese cabbage is a promising early vegetable crop. In Ukraine, there is a small assortment of domestic varieties and hybrids of Chinese cabbage with a high potential for productivity of various ripeness groups, indicators of the quality of commodity and seed production that are resistant to diseases [5, 8]. Therefore, an important element of agricultural technology for the cultivation of Chinese cabbage is the selection of modern varieties and hybrids of the intensive type, high-yielding, resistant to bolting. Their diversity is much less than that of white cabbage and they differ mainly in the shape and weight of the head. Varieties and hybrids with elongated cylindrical heads are more popular.

Chinese cabbage is quite demanding on growing conditions, especially in greenhouses [7]. Market for its products is growing every year and is associated with a rich chemical composition, medicinal properties and long-term storage ability [1, 8].

One of the requirements for choosing is bolt-resistant varieties. Varieties and hybrids are divided into two groups according to the timing of cultivation, in particular, are recommended for spring and autumn cultivation. The size of the head of cabbage depends on the biological characteristics of the variety or hybrid and the density of sowing or seedling planting schemes. The mass of the head can vary from 1 to 5 kg or more, depending on the growing technology. Heads weighing 0.8–1.5 kg are more popular among consumers [1, 9, 10]. A characteristic feature of most hybrids is the ability of the leaves not to lose their dark green color even during prolonged storage.

In Ukraine, there is currently a tendency for cultivation of hybrids of domestic and foreign breeding, which is associated with the growing requirements of plant resistance to disease, yield and quality of production [2].

The purpose of the research is to study the economic and biological features and uncover the genetic potential of various hybrids of Chinese cabbage, depending on the climatic zone of cultivation.

Materials and methods

The studies were carried out during 2017–2019 at the experimental field of the Department of Vegetable Growing of the Uman NUH on black soil podzolic heavy-loam, which was marked by a deep occurrence of carbonates (115–120 cm) and low content in the arable layer of humus (1.92–2.1%). According to the problem laboratory of the Uman NUH, the reaction of the soil solution was slightly acidic (pH 6.25), hydrolytic acidity of 2.46 mg-eq/100 g of soil, the content of mobile forms of phosphorus 280 mg/kg and potassium 278 mg/kg (according to Chirikov), nitrogen alkaline-hydrolyzed compounds (according to Kornfield) 105.7 mg/kg.

In 2017 the weather conditions were slightly different from perennial values. The spring was long and moderately warm with insufficient rainfall compared to annual average. Average air temperatures in March were 5.5 °C above the climate normals. Summer of 2017 was warm (average air temperature for the season was 20.9 °C, which is 2.6 °C above the climate normals), precipitation was 130.1 mm, that is 102.9 mm below the climate normals. The average air temperature in June, July and August was 20.0; 20.6 and 22.1 °C, what was 2.4; 1.6 and 3.9 °C above normal for the Right-Bank Forest Steppe. A feature of that summer was the average monthly August temperature, what was higher than July one. In 2018, the amount of precipitation was 680.6 mm, that is, 47.6 mm more than the climate normals, and the average air temperature by 2.3 °C exceeded the traditional long-term average and was 9.7 °C. The summer season was characterized by downpours. Thus, in June their number was only 41 mm, which was less by 46 mm of the climate normals, and in July and August they were by 27.8 and 29.1 mm less than the average values. In 2019 weather conditions were characterized by uneven rainfall and extremely high temperatures, especially in July, an abnormally hot last decade and extremely hot August with an excess of 37 °C. In general, the weather conditions during the years of re-

search were typical of the specified area of cultivation.

The object of the study was hybrids of Chinese cabbage of foreign breeding – ‘Pioneer F₁’ (control), ‘Vili F₁’, ‘Manoko F₁’, ‘Orient Star F₁’, ‘Vitimo F₁’, ‘Sprinkin F₁’, ‘Summer Highland F₁’, ‘Suprin F₁’, ‘Richi F₁’, listed in the Register of plant varieties of Ukraine. All hybrids are suitable for cultivation in the Forest-Steppe zone. The average mass of the head is from 1.5 to 2.5 kg, they are characterized by high resistance to disease, bolting and high uniformity. The growing season lasts 60–85 days.

The container seedlings (40 days old) were planted in the middle of April according to the scheme 70 cm by 25 cm, i. e. 57.1 thousand plant/ha. The area of the accounting site was 21 m². The experiment was laid out in a randomized block design with four replications. During the growing season of plants, their phenology was monitored, measurements were made, and analyzes were performed using conventional methods [10]. The content of dry soluble and insoluble substances, ascorbic acid, and nitrates was determined in finished products in laboratory conditions [11]. Plants were cared for in accordance with the requirements of this culture and research questions. They were wa-

tered as needed, hilled up, protected from pests and diseases; the soil in the aisles was loosened, weeds were removed. Statistical processing of the results was performed using computer software Excel and Statistica 6.0 [12].

Results and discussion

Monitoring the rate of passage of the main phenological phases of Chinese cabbage showed that, having been planted within the same time frame seed germination was not simultaneous. The first sprouted seeds (4 days after seeding) belonged to hybrids ‘Vili F₁’, ‘Manoko F₁’, ‘Orient Star F₁’ and ‘Summer Highland F₁’. Seeds of the other hybrids started active germination on the 5–6 days after seeding. Even sprouts were in ‘Vili F₁’ and ‘Summer Highland F₁’ (95% germination). The beginning of head formation was observed in the second decade of May in all variants. The duration of the growing season over the course of research was influenced by the sum of effective air temperatures. According to this indicator, most of the hybrids were at the control level 61–62 days from seedlings, unlike ‘Richi F₁’ hybrid, where the phase of head formation occurred on average 4 days later during the years of studies (Table 1).

Table 1

The duration of the interphase periods in hybrids of Chinese cabbage, days

Hybrids	Mass sprouts	Sprouts – the beginning of head formation	Sprouts – technical maturity
‘Pioneer F ₁ ’ – control	5	62	90
‘Vili F ₁ ’	4	62	89
‘Manoko F ₁ ’	4	62	89
‘Orient Star F ₁ ’	4	64	87
‘Vitimo F ₁ ’	6	64	92
‘Summer Highland F ₁ ’	4	62	89
‘Sprinkin F ₁ ’	5	62	87
‘Suprin F ₁ ’	6	61	85
‘Richi F ₁ ’	5	66	93

‘Sprinkin F₁’ hybrid (85 days after sprouting) entered the technical maturity stage early, 5 days faster than the control. The long growing season was observed in the ‘Richi F₁’ hybrid – 93 days. The duration of the growing season in other variants was at the level of control.

In the phase of the beginning of head formation, plants of ‘Sprinkin F₁’ hybrid (16.5 cm) were tall at the control level. This indicator was at the same level in hybrids ‘Vili F₁’ and ‘Summer Highland F₁’, respectively 15.7 and 15.5 cm. The lowest plant height was observed in hybrids ‘Richi F₁’ (14.5 cm), which is explained by the varietal features of plants. In the technical ripeness phase, the plants differed between variants on this indicator. Thus, the plant height of ‘Pi-

oner F₁’ hybrids (control), ‘Vili F₁’ and ‘Summer Highland F₁’ was almost the same, with a slight difference. Hybrid ‘Sprinkin F₁’ (31.5 cm) had the highest growth force, the smallest was in ‘Richi F₁’ hybrid (24.0 cm), which is 3.1 cm less than in the control. During the growing season the number of leaves in the rosette was determined in dynamics. In the phase of the beginning of head formation, more leaves were formed by the plants of hybrids ‘Vili F₁’ and ‘Summer Highland F₁’, respectively 13.5 and 13.0 pcs./plant, 2.6–3.1 more than in the control. The lowest number of leaves was observed in hybrid ‘Richi F₁’ – 9.1 pcs./plant, less than in the control variant.

In the phase of technical maturity, the biggest leafage of plants was observed in hybrids ‘Vili F₁’ and ‘Sprinkin F₁’; on average over the

Table 2

Quantitative indicators of the chinese cabbage harvest structure

Hybrids	Head diameter, cm	Head height, cm	Head mass, kg
'Pioneer F ₁ ' – control	11.9	26.8	1.4
'Vili F ₁ '	14.2	20.5	2.1
'Manoko F ₁ '	12.8	19.8	1.9
'Orient Star F ₁ '	13.0	20.4	2.0
'Vitimo F ₁ '	12.7	22.1	2.3
'Summer Highland F ₁ '	15.6	24.7	1.8
'Sprinkin F ₁ '	11.8	22.8	1.3
'Suprin F ₁ '	13.1	21.9	2.1
'Richi F ₁ '	12.5	17.8	0.95
LSD _{0.05}	0.3	0.5	0.4

years of research, the number of leaves was 21.7 and 21.4 pcs./plant, which was 1.6 and 1.3 pcs. more than in the control. Plants of hybrid 'Summer Highland F₁' in this phase formed the smallest number of leaves 18.3 pcs., what was 1.8 pcs. less than in the control.

Fig. 1. Plants of the hybrid 'Summer Highland F₁'

Qualitative indicators, on average, did not vary significantly over the years. In the structure of the commercial crop of Chinese cabbage, the height, weight and diameter of the heads were determined (Table 2). Analysis of the results showed that on average the highest height (14.2 and 15.6 cm) and the head weight (2.1 and 1.7 kg) were in hybrids 'Vili F₁' and 'Summer Highland F₁', respectively by 2.3 and 3.7 cm and 0.7 and 0.4 kg more than in the control, what had a positive effect on the value of gross product. 'Sprinkin F₁' hybrid formed narrowed heads with a diameter of 11.8 cm, a height of 21.9 cm and a mass of 1.3 kg, which was almost at the level of the control. In hybrids 'Manoko F₁', 'Orient Star F₁', 'Vitimo F₁', 'Suprin F₁' the weight of the head was 1.9; 2.0; 2.3 and 2.1 kg respectively. The smallest weight was noted in hybrid 'Richi F₁' – 0.95 kg, which was 0.45 kg less than in the control variant.

To assess the degree of maturity of the variety the beginning of production and the value of the crop is of great importance. According to the results of research, the technical maturity of Chinese cabbage hybrids occurred in the first decade of June. The heads were cut with a knife at a minimum mass of 250–300 g.

On average, during the study period, high commercial yields of heads were obtained in hybrids 'Vili F₁' (31.7 t/ha) and 'Sprinkin F₁' (28.7 t/ha), which were 10.0 and 7.0 t/ha more

than in the control (Table 3, Fig. 2). The yields of 'Summer Highland F₁' (24.9) and 'Suprin F₁' (24.6 t/ha) hybrids were significantly lower. The low yield of marketable products is due to the lower resistance of plants to higher temperatures in the late spring, which led to the formation of loose and smaller heads. 'Monoko F₁' and 'Vitimo F₁' hybrids had almost identical yields, which were +1.2 and +1.5 t/ha, respectively.

Fig. 2. Cabbage head of hybrid 'Sprinkin F₁'

Depending on the weather conditions, the yield of Chinese cabbage hybrids varied separately by year. On average, in the years of research, the greatest increase to control was in hybrids 'Vili F₁' and 'Sprinkin F₁'. The control variant 'Pioneer F₁' had the lowest yield – 21.7 t/ha on average during the years of research.

Table 3

Commodity yield of Chinese cabbage hybrids

Hybrids	Commodity yield, t/ha				± to control
	2017	2018	2019	mean	
'Pioneer F ₁ ' – control	22.0	21.4	21.8	21.7	–
'Vili F ₁ '	35.2	29.5	30.5	31.7	+10.0
'Manoko F ₁ '	23.1	22.7	23.0	22.9	+1.2
'Orient Star F ₁ '	23.5	24.3	24.6	24.1	+2.4
'Vitimo F ₁ '	23.4	23.2	23.0	23.2	+1.5
'Summer Highland F ₁ '	25.5	24.4	24.8	24.9	+3.2
'Sprinkin F ₁ '	30.6	28.3	27.4	28.7	+7.0
'Suprin F ₁ '	26.1	24.2	23.7	24.6	+2.9
'Richi F ₁ '	21.9	21.7	22.3	20.9	+0.2
LSD _{0.05}	1.4	1.7	1.2	1.5	–

Studies have also shown that Chinese cabbage yields differed not only in biometrics but also in chemical composition. The obtained

results indicate that the highest soluble solids content was in the heads of 'Summer Highland F₁' hybrids (6.2%) and 'Sprinkin F₁' (5.9%), what was 1.1 and 0.8% more than in the control, respectively. There was no significant difference in the amount of sugars over the variants, this indicator was at the level of control (1.7–2.1%). The content of ascorbic acid was in the range of 38.6–45.0 mg, this indicator was in hybrid 'Vili F₁' – 45.0 mg, which is 6.4 mg more than in the control. The content of nitrates in the cabbage heads of the studied Chinese cabbage hybrids was within the tolerance limit and amounted to 600 mg/kg (fresh mass) and ranged from 350 mg/kg in 'Summer Highland F₁' hybrid to 465 mg/kg wet weight in 'Vili F₁' hybrid (Table 4).

Table 4

Biochemical composition of Chinese cabbage heads

Hybrids	Content in heads			Sum of sugars, %
	soluble dry matter, %	ascorbic acid, mg	nitrates, mg/kg	
'Pioneer F ₁ ' – control	5.1	38.6	498	1.7
'Vili F ₁ '	5.5	45.0	465	2.1
'Manoko F ₁ '	5.2	41.1	421	1.8
'Orient Star F ₁ '	5.2	40.8	453	1.8
'Vitimo F ₁ '	5.4	41.0	445	1.7
'Summer Highland F ₁ '	6.2	41.6	350	2.0
'Sprinkin F ₁ '	5.9	42.1	411	1.8
'Suprin F ₁ '	5.0	41.4	468	1.9
'Richi F ₁ '	5.2	40.7	457	1.7

Therefore, under the conditions of unstable soil moisture, hybrids 'Vili F₁' and 'Sprinkin F₁' appeared the most productive and ensured yield increase of 10.0 t/ha and 7.0 t/ha, respectively, compared to the control; and the production was of high commercial quality.

Conclusion

Monitoring the rate of passage of the main phenological phases of Chinese cabbage showed that, having been planted within the same time frame seed germination was not simultaneous. The first sprouted seeds (4 days after seeding) belonged to hybrids 'Vili F₁', 'Manoko F₁', 'Orient Star F₁' and 'Summer Highland F₁'. Seeds of the other hybrids started active germination on the 5–6 days after seeding. 'Sprinkin F₁' hybrid entered the phase of technical ripeness earlier (85 days after germination), which was 5 days faster than in the control. A long vegetation period was observed in the hybrid 'Richi F₁' – 93 days. The duration of the growing season in other hybrids was at the control level.

The biometric indicators of cabbage showed that in the phase of the beginning of head for-

mation plants of 'Sprinkin F₁' hybrid (16.5 cm) were the highest, at the control level. This indicator was at the same level in 'Vili F₁' and 'Summer Highland F₁' hybrids, respectively 15.7 and 15.5 cm. The lowest plant height was observed in 'Richi F₁' hybrid (14.5 cm), due to varietal characteristics of plants.

In the phase of technical maturity, the biggest leafage of plants was observed in hybrids 'Vili F₁' and 'Sprinkin F₁'; on average over the years of research, the number of leaves was 21.7 and 21.4 pcs./plant, which was 1.6 and 1.3 pcs. more than in control. Plants of hybrid 'Summer Highland F₁' in this phase formed the smallest number of leaves 18.3 pcs., what was 1.8 pcs. less than in the control.

The highest commodity crop of heads was obtained for the hybrids 'Vili F₁' (31.7 t/ha) and Sprinkin F1 (28.7 t/ha), which was 10.0 and 7.0 t/ha more than in the control. The yields of 'Summer Highland F₁' hybrids were significantly lower – 24.9 and the 'Suprin F₁' – 24.6 t/ha.

The highest soluble solids content was in the heads of hybrids 'Summer Highland F₁' (6.2%) and 'Sprinkin F₁' (5.9%), which was 1.1 and

0.8% more than in the control. By the amount of sugars, there was no significant difference between the options; this indicator was at the control level (1.7–2.1%). The nitrate content in the heads of the studied hybrids of Chinese cabbage was within the permissible norm and amounted to 600 mg/kg of wet weight.

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Ковтунюк З. І.¹, Войтовська В. І.², Сторожик Л. І.² Господарсько-біологічна оцінка гібридів капусти пекинської [*Brassica rapa* L. var. *pekinensis* (Lour.) Kitam.] за вирощування в умовах Правобережного Лісостепу України // *Plant Varieties Studying and Protection.* 2020. Т. 16, № 1. С. 40–47. <https://doi.org/10.21498/2518-1017.16.1.2020.201026>

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Мета. Дослідити господарсько-біологічні особливості та розкрити генетичний потенціал різних гібридів капусти пекинської залежно від кліматичної зони вирощування. **Методи.** Варіантами досліду були гібриди капусти пекинської 'Pioneer F₁' (контроль), 'Vili F₁', 'Manoko F₁', 'Orient Star F₁', 'Vitimo F₁', 'Sprinkin F₁', 'Summer Highland F₁', 'Suprin F₁', 'Richi F₁'. Площа облікової ділянки 21 м². Дослід закладався в чотирьох повтореннях, досліджувані варіанти розміщували методом рендомізованих блоків. Касетну розсаду віком 40 діб висаджували в другій декаді квітня за схемою 70 × 25 см. **Результати.** За одного строку сівби у гібридів сходи з'являлись неодноразово і перші відмічено у гібридів 'Vili F₁', 'Manoko F₁', 'Orient Star F₁' та 'Summer Highland F₁' – на 4 добу після сівби, а у решти – масові сходи спостерігали дещо пізніше, на 5–6 добу після сівби. Найвищий товарний врожай головок одержали у гібридів 'Vili F₁' (31,7 т/га) та 'Sprinkin F₁' (28,7 т/га), що на 10,0 і 7,0 т/га більше, ніж у контролі. Істотно нижчою була врожайність у гібридів 'Summer Highland F₁' – 24,9 і 'Suprin F₁' – 24,6 т/га. В умовах нестійкого зволоження врожайнішими були гібриди 'Vili F₁' та 'Sprinkin F₁', які забезпечили приріст урожаю до контролю

10,0 і 7,0 т/га, а продукція була високої товарної якості. Найвищий відсоток сухих розчинних речовин був у головках гібридів 'Summer Highland F₁' (6,2%) і 'Sprinkin F₁' (5,9%), що на 1,1 і 0,8% більше за контроль. За сумою цукрів не відмічено істотної різниці між варіантами, даний показник був на рівні контролю (1,7–2,1%). Уміст нітратів у головках досліджуваних гібридів капусти пекинської був у межах допустимої норми – 600 мг/кг сирової маси. **Висновки.** Фенологічні спостереження за розвитком рослин та їхні біометричні показники залежно від сортових особливостей вказують, що в умовах нестійкого зволоження врожайнішими були гібриди 'Vili F₁' та 'Sprinkin F₁', які забезпечили приріст урожаю до контролю 10,0 і 7,0 т/га, а продукція була високої товарної якості. Тривалий період вегетації у гібриду 'Richi F₁' – 93 доби, не вплинув на якість і врожайність та забезпечив найнижчі показники відносно контрольного і досліджуваних варіантів.

Ключові слова: головка; біометричні показники; фенологічні спостереження; вміст нітратів; урожайність.

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Ковтунюк З. І.¹, Войтовская В. И.², Сторожик Л. И.² Хозяйственно-биологическая оценка гибридов капусты пекинской [*Brassica rapa* L. var. *pekinensis* (Lour.) Kitam.], выращенных в условиях Правобережной Лесостепи Украины // *Plant Varieties Studying and Protection.* 2020. Т. 16, № 1. С. 40–47. <https://doi.org/10.21498/2518-1017.16.1.2020.201026>

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Цель. Исследовать хозяйственно-биологические особенности и раскрыть генетический потенциал различных гибридов капусты пекинской в зависимости от климатической зоны выращивания. **Методы.** Вариантами опыта были гибриды капусты пекинской 'Pioneer F₁' (контроль), 'Vili F₁', 'Manoko F₁', 'Orient Star F₁', 'Vitimo F₁', 'Sprinkin F₁', 'Summer Highland F₁', 'Suprin F₁', 'Richi F₁'. Площадь учетного участка 21 м². Опыт закладывался в четырех повторениях, исследуемые варианты размещали методом рендомизированных блоков. Кассетную рассаду в возрасте 40 суток высаживали во второй декаде апреля по схеме 70 × 25 см. **Результаты.** В один срок посева у гибридов всходы появлялись не одновременно и первые отмечены

у гибридов 'Vili F₁', 'Manoko F₁', 'Orient Star F₁' и 'Summer Highland F₁' – на 4 сутки после посева, а в остальных – массовые всходы наблюдались несколько позже, на 5–6 сутки после посева. Самый высокий товарный урожай головок получили у гибридов 'Vili F₁' (31,7 т/га) и 'Sprinkin F₁' (28,7 т/га), что на 10,0 и 7,0 т/га больше, чем в контроле. Существенно ниже была урожайность у гибридов 'Summer Highland F₁' – 24,9 и 'Suprin F₁' – 24,6 т/га. В условиях неустойчивого увлажнения более урожайными были гибриды 'Vili F₁' и 'Sprinkin F₁', которые обеспечили прирост урожая к контролю 10,0 и 7,0 т/га, а продукция имела высокое товарное качество. Самый высокий процент сухих растворимых веществ установлен в головках гибридов

'Summer Highland F₁' (6,2%) и 'Sprinkin F₁' (5,9%), что на 1,1 и 0,8% больше контроля. По сумме сахаров не отмечено существенной разницы между вариантами, данный показатель был на уровне контроля (1,7–2,1%). Содержание нитратов в головках исследуемых гибридов капусты пекинской было в пределах допустимой нормы 600 мг/кг сырой массы. **Выводы.** Фенологические наблюдения за развитием растений и их биометрические показатели в зависимости от сортовых особенностей указывают, что в условиях неустойчивого увлажнения более урожайными

были гибриды 'Vili F₁' и 'Sprinkin F₁', которые обеспечили прирост урожая к контролю 10,0 и 7,0 т/га, а продукция была высокого товарного качества. Длительный период вегетации у гибрида 'Richi F₁' – 93 суток не повлиял на качество и урожайность культуры и обеспечил низкие показатели относительно контрольного и исследуемых вариантов.

Ключевые слова: качан; биометрические показатели; фенологические наблюдения; содержание нитратов; урожайность.

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