

## STUDY OF THE INFLUENCE OF THE PERIOD OF ESTABLISHMENT OF THE AUTUMN CROP IN CHINESE CABBAGE GROWN IN GREENHOUSES

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### RESEARCH ARTICLE

#### Abstract

*Chinese cabbage is an annual plant, but in Romanian climatic conditions it is grown as a biennial plant. It has two types, Pe Tsai and Pak choi. It is native to Eastern Asia; China and Japan are the biggest growers. Chinese cabbage has a high content of vitamins, minerals and active principles. The calcium included in Chinese cabbage is bioavailable to the human body and is found in sufficient quantities. For the fall crop, the period of crop establishment influences the emergence of flowering stems and total production. Of the two varieties, Pak choi is more sensitive to the emission of flowering stems.*

**Keywords:** Chinese cabbage, pak choi, pe tsai, flowering stems

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#### INTRODUCTION

Chinese cabbage is a biennial plant, but due to the short vegetation period, it behaves like an annual species. Chinese cabbage is present in culture under two varieties: *Brassica campestris* var. *pekinensis* (Pe tsai) and *Brassica campestris* var. *chinensis* (Pak choi).

The origin of this species is in Eastern Asia, in China it has been cultivated since the 10th century. On the European continent it appears in the century. the 18th century, but only in the 20th century does the species show interest, both in Europe and America. Being native to Asia, the highest consumption is found in China and Japan, in fact cabbage occupies the largest areas in Asia. In Romania, Chinese cabbage is cultivated sporadically on small areas, most of the production found on the market comes from imports. The consumption trend is increasing.

The two varieties of Chinese cabbage are eaten either raw in the form of salads, in association with other greens, it has a pleasant sweet-sour, slightly spicy taste, or cooked in various forms. In China, it is widely consumed in lacto-fermented form, especially the Pe tsai variety.

The consumption of Chinese cabbage is recommended, not only for the taste and finesse

of culinary preparations, but for the wealth of vitamins, minerals and active principles. Food Data Central presents the nutritional values for 100g Chinese cabbage: Water 96.3g, Energy 12 kcal, Protein 1.1g, Total lipid (fat) 0.17g, Ash 0.17g, Carbohydrate by difference 2.23g, Calcium, Ca 29mg, Iron, Fe 0.74 mg, Magnesium, Mg 8mg, Phosphorus, P 19 mg, Potassium, K 87 mg, Sodium, Na 11 mg, Zinc, Zn 0.14 mg, Manganese, Mn, 0.203 mg, Vitamin C, total ascorbic acid 3.2 mg, Vitamin B- 6 0.037 mg, Vitamin B-6 0.037mg, Vitamin A, RAE 13 µg, Carotenes, beta 133 µg, Vitamin A, IU 263 IU.

When it comes to cruciferous vegetables (broccoli, cauliflower, cabbage, Chinese cabbage, etc.), research shows that regular consumption may help prevent several types of cancer, such as lung, pancreatic, ovarian, and kidney cancers (Brennan et al, 2005).

However, it seems that this protective effect would not be the same in all individuals due to genetic factors (. Lampe JW, Peterson S.). In addition, a study showed a link between frequent consumption of cruciferous vegetables (more than 30 times per month) and a lower concentration of homocysteine in the blood (Ganji, Kafai, 2004). High blood homocysteine concentrations have been associated with an increased risk of cardiovascular disease (Guthikonda, Haynes, 2006). In a large study

(over 100,000 subjects), individuals who consumed Chinese cabbage almost every day had a 50% lower risk of urinary tract cancer than those who consumed it less than once or twice a month (Sakauchi, et al, 2005). A similar trend is seen in other studies evaluating the consumption of Chinese cabbage and the incidence of various types of cancer (prostate, gastrointestinal, brain) (Kristal, Lampe, 2002.).

Chinese cabbage contains glucosinolates, in smaller amounts than most other cruciferous vegetables. In addition, the variety Pak-choi (Bok choy) is said to contain about twice as much as Peking cabbage (Pe-tsai) (McNaughton Marks, 2003) Chinese radish contains considerable amounts of carotenoids, especially in the form of beta -carotene. Carotenoids are compounds that also have antioxidant properties (Stahl, Sies, 2005). Chinese cabbage is one of the vegetables that contains the most bioavailable calcium, meaning calcium that the body can absorb and use. The bioavailability of calcium from some vegetables (mainly green leafy vegetables) is variable. Bok choy contains a significant amount of calcium (84 mg per 125 ml serving) and is highly bioavailable (54% absorption rate) (Miller et al., 2001).

#### MATERIAL AND METHOD

The current research aims to establish an optimal interval for the establishment of the culture that avoids the appearance of flowering stems, with direct effects on production. The research took place in a small ecological vegetable farm in the town of Husășău de Tinca,

located in NW of Romania, in the year 2021. To achieve the proposed objectives, two monofactorial experiments were established for each variety of Chinese cabbage. Each experiment had six variants in three repetitions.

Each variant had 50 plants. The biological material was represented by the type of cabbage pak choi and pe tsai. The arrangement of the variants was been done according to the method of subdivided blocks. The statistical processing of the experimental data was done by analysis of variance.

Experimental variants  
 V1 Pc V1 Pt – sown 22.08  
 V2Pc V2 Pt – sown 03.09  
 V3 Pc V3 Pt – sown 12.09  
 V4Pc V4 Pt – sown 26.09.  
 V5 Pc V5 Pt – sown 03.10  
 V6Pc V6 Pt – sown 14.10

#### RESULTS AND DISCUSSIONS

For the production of seedlings, for both varieties, alveolar trays were used for seeding, at the corresponding dates from the proposed variants.

Seedlings were planted in all variants 30 days after emergence.

The first aspect pursued in the experiment was the identification of the plants that emitted flowering stems.

The data related to the emission of flowering stems was described in table no. 1.

Table 1

**Plants that did not produce flowering stems after planting  
 Husășău de Tinca, 2021**

Cr. No.	Variant	Total of plants	Plants without strains (nr.)	Plants Without strains (%)	Cr. No.	Variant	Total of plants	Plants without strains (nr.)	Plants without strains (%)
1	V1 Pc	50	48	96	1	V1 Pt	50	49	98
2	V2 Pc	50	49	98	2	V2 Pt	50	50	100
3	V3 Pc	50	50	100	3	V3 Pt	50	50	100
4	V4 Pc	50	47	94	4	V4 Pt	50	50	100
5	V5 Pc	50	32	64	5	V5 Pt	50	48	96
6	V6 Pc	50	10	20	6	V6 Pt	50	21	42

In the Pak choi variety, it was noticed that only in the V3 Pc variant none of the 50 plants planted produced flowering stems. In the other variants, the percentage of plants that emitted flowering stems was 4% at V1 Pc and up to 80% at V6 Pc. Basically the late establishment of the culture determined the appearance of flower stalks.

In the other cabbage variety (Pe tsai), the variants V2 Pt, V3 Pt and V4 Pt had a normal growth so that no plant produced flower stalks. And in the case of this type of cabbage, the late establishment of the culture influenced the appearance of flowering stems in 29 plants out of the total of 50 (V6 Pt).

The appearance of flowering stems in Chinese cabbage varieties directly influences

the total production per unit area. In case of plants with flowering stems, a few leaves can be used in greens mixture for salads.

In the second part of the research, the influence of the culture establishment period on the production potential of the two types of Chinese cabbage was analyzed. The production of Chinese cabbage variety Pak choi was presented in table no. 2. Production data were processed statistically by analysis of variance.

For each variant, plants with flowering stems appearing before the harvest period negatively influence production per surface unit. In the case of the present experiment, the average of the variants was chosen as the control. The best production results were obtained with the V3 Pc variant with a production increase compared to the control of over 40%, the difference being statistically very significantly positive. Good results were also recorded with the V2 Pc variant from which they harvested 1.24 kg/m<sup>2</sup> more than the experience average.

The difference from this was ensured statistically positively very significant. Even if it was sown very early, the plants from the V1 Pc variant obtained results superior to the average of the experience, but with a somewhat reduced increase of 14.2% compared to the control. The difference was positively statistically significant. The V4 Pc variant, even if it recorded a production above the average of the experience, the difference did not exceed the p=5% threshold and was not statistically ensured.

The later establishment of V5 Pc and V6 Pc variants resulted in the emission of flowering stems in many plants, which greatly influenced production. Thus the V5 Pc obtained only 69.58% of the average production of the experience, respectively 38.07% in the case of the V6 Pc variant. In both variants, the difference compared to the control was statistically very significantly negative.

Table 2

**Production of chinese cabbage Pak choi  
Husasău de Tinca, 2021**

Cr. no.	Variant	Absolute production of Pak choi kg/m <sup>2</sup>	Relative production of Pak choi %	± d kg/m <sup>2</sup>	Significance
1	V1 Pc	5.23	114.42	+0.66	X
2	V2 Pc	5.81	127.13	+1.24	XX
3	V3 Pc	6.72	141.47	+2.15	XXX
4	V4 Pc	4.75	104.59	+0.18	-
5	V5 Pc	3.18	69.58	-1.39	000
6	V6 Pc	1.74	38.07	-2.83	000
7	Mt. Average	4,57	100,00	0.00	-

LSD<sub>5%</sub>=0.54 LSD<sub>1%</sub>=0.88 LSD<sub>0,1%</sub>=1.15

Table no. 3 shows the production data obtained for the 6 varieties of Chinese cabbage, the Pe tsai variety. In this case the witness was represented by the average of the experience.

Comparing the productions of the two types of Chinese cabbage as a whole, it can be noted that in the case of the Pe tsai variety, the productions were closer to the average of the experience compared to the Pak choi variety, where the differences from the average were much larger.

Analysis of production data from table no. 3 highlighted the V2 Pt variant which recorded an absolute production of 98.5 t/ha (a very good production) and a production increase compared to the average of 24.68%.

The difference from the control was statistically positively distinctly significant. The V3 variant obtained 1.34 kg/m<sup>2</sup> more than the control, the difference being statistically positively significant. Also, in the case of the Pe tsai variety, the late establishment of the crop caused the mass appearance of flowering stems. The phenomenon was observed in the V6 Pt variant, which obtained only 52.53% of the experience average. The difference from the control was statistically highly significant negative.

The other variants achieved production results close to the experience average, but did not exceed the p=5% threshold, so they were not statistically assured.

**Production of chinese cabbage Pe tsai  
Husasău de Tinca, 2021**

Cr. no.	Variant	Absolute production of Pe tsai kg/m <sup>2</sup>	Relative production of Pe tsai %	± d kg/m <sup>2</sup>	Significance
1	V1 Pt	8.12	102.78	+0.22	-
2	V2 Pt	9.85	124.68	+1.95	XX
3	V3 Pt	9.24	116.96	+1.34	X
4	V4 Pt	8.71	110.25	+0.81	-
5	V5 Pt	7.36	93.16	-0.54	-
6	V6 Pt	4.15	52.53	-3.75	000
7	Mt. Average	7.90	100.00	0.00	-

LSD<sub>5%</sub>=0.94 LSD<sub>1%</sub>=1.54 LSD<sub>0.1%</sub>=2.01

### CONCLUSIONS

The research regarding the influence of the period of establishment of the Chinese cabbage culture led to several conclusions:

The sowing and planting period of the Chinese cabbage crop directly influences both the emergence of flowering stems and production.

For the fall crop of Chinese cabbage, both sowing in late August and mid-October had caused premature emergence of flowering stems.

The interval with the optimal sowing period is much narrower in the Pak choi variety compared to the Pe tsai variety.

In the case of the Pak choi variety, the V3 Pc variant sown on 12 September recorded the highest absolute production of 67.2 t/ha.

At the Pak choi variety, the V6 Pc variant sown on October 19, due to the premature appearance of the flower stalks, has determined a very low production of only 1.74 kg/m<sup>2</sup>.

In the case of the Pe tsai variety, the V2 Pt variant sown at the beginning of September achieved the highest production. The production was 9.85 kg/m<sup>2</sup>.

Sowing in the middle of October in the case of the V6 Pt variant caused the appearance of flowering stems in a fairly large number of plants, but less than in the Pak choi variety sown in the same period.

Comparing the production potential of the two types of Chinese cabbage, much higher productions were noticed in the Pe tsai variety.

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