RESEARCH ON THE INFLUENCE OF DENSITY AND VARIETY UPON THE PRODUCTION OF ORGANIC CHINENSE CABBAGE GROWN IN POLYETHYLENE TUNNELS

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RESEARCH ARTICLE

Abstract

In this research we wanted to identify how density and variety influence Chinese cabbage production. The research was carried out in the autumn of 2023, in an organically certified microfarm, located in the North-West of Romania com. Husasău de Tinca. The experiment was a polyfactorial one, with two factors and three repetitions, each variant having 50 plants. Factor 1 is the variety with three graduations, namely V1 Pak choi, V2 Pe tsai and V3 Tat soi. The second factor is the density with three graduations D1 80,000 plants per ha, D2 60,000 plants per ha and D3 70,000 plants per ha. The statistical processing of the experimental data was done by analysis of variance for polyfactorial, completely randomized experiments. The experience was set up in a 50 m long, 10 m wide and 4.5 m high polyethylene tunnel.

Keywords: Chinese cabbage, density, variety, organic
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INTRODUCTION

The assortment of greens traditionally grown in Romania during the cold period of the year is mainly lettuce, spinach, green onions. However, taking into account the existing pedoclimatic conditions, the possibility of producing other vegetables during this period is much greater. For example, Kale, Arugula, Mizuna cabbage, Chinese cabbage, etc. All these vegetables can be grown in the climatic conditions of our country with favorable results.

Chinese cabbage, which is part of the Brassicaceae family, is cultivated internationally, especially in Asia. Brassicaceae is a diverse family of angiosperms containing 338 genera and 3709 species (Warwick et al, 2006), including Brassica rapa L. Brassica rapa L is an economically important species and exhibits extreme morphological divergence (referred to as morphotypic) (Takumi et al, 2021). Chinese cabbage was taken into cultivation, in China, starting in the 10th century, and in Europe in the 18th century. (Cărbunar et al, 2022).

Due to its nutritional qualities, but also to the different ways of being consumed, we believe that Chinese cabbage deserves to become an increasingly present vegetable in the diet.

In a 2022 study (Jie Wang et. al, 2022), in which a comparison was made between three genera of the Brasica family, namely, cabbage (Brassica oleracea L. var. capitata L.), cauliflower (Brassica oleracea var. botrytis), and Chinese cabbage (Brassica rapa L. ssp. pekinensis), the nutritional differences that Chinese cabbage has are notable. Chinese cabbage ranks first in vitamin C content, as well as minerals such as K, Mn, Mg, Ca, P, and Zn (Jie Wang et. al, 2022).

Taking into account these results, but also the desire and need to have a wider palette of cultivated greens, the present paper aims to determine the influence of density and variety on Chinese cabbage production.

MATERIAL AND METHOD

Brassica rapa L. is characterized by a high diversity. We present in figure 1 a representative selection of morphotypes of Brassica rapa L. (Feng Cheng, et. all., 2016).

Figure 1 **Varieties of Brassica rapa L.**

Source: Feng Cheng, et. All., 2016, Genome resequencing and comparative variome analysis in a Brassica rapa and Brassica oleracea collection, https://www.nature.com/articles/sdata2016119

Of all the varieties of Chinese cabbage, the present research was carried out on three varieties of Chinese cabbage, namely Brassica rapa L. ssp. pekinensis (Pe tsai), Brassica rapa L. ssp. chinensis (Pak choi) and Brassica rapa L. ssp. rosularis (Tat soi), grown in organic cultivation.

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Brassica rapa L. ssp. pekinensis (Pe tsai) also called Napa cabbage is one of the most important vegetables in East Asia. It forms a vertical head either of tightly overlapping leaves, or sometimes a looser head of more widely separated leaves. The shape and size differ significantly between varieties, and the weight of the head can vary from 1.4 to 4.5 kg. The color of the leaves in the center of the heart is usually creamy-white, but the outer leaves range from dark green to light green. The swollen bases of the leaves often form a solid white base (Fordham et all, 2003). It is used in gastronomy for the preparation of Kimchi, the most popular Korean fermented food. In this form, Chinese cabbage is considered a rich source of bioactive compounds (Gitishree et al, 2012).

Brassica rapa L. ssp. chinensis (Pak choi) is a leafy vegetable that originates from southern China. It is known for its juicy and crunchy texture, but also for the sweetness of its flowering shoots (NLB, 2024).

In gastronomy it is used fresh, roasted or boiled. The leaves are sometimes preserved by salting or drying. In French Indochina they are used to prepare a drink with beneficial effects on health. Colza oil is made from the seeds (NLB, 2024)

Brassica rapa L. ssp. rosularis (Tat soi), also called rosette Pak choi or flat cabbage, has very thick, black-green, shiny leaves, arranged in a rosette of concentric circles, with prostrate and straight varieties. The leaves range from flat and smooth to wrinkled and crepe-like (NCSU, 2024).

Similar in flavor to Pak choi, Tat soi can be used at all stages: seedling leaves, small rosettes, large plants and young flowering shoots. The young leaves and small rosettes are used raw, in salads and fried. Tat soi can also be cooked in soups, or added to pasta (NCSU, 2024).

In the previous culture there were eggplants. After the dismantling of the crop, the land was fertilized with compost obtained on his own farm, which was incorporated with the ploughing in early November. The shredding of the land was done using the combiner. After preparing the land, the drip watering system and mulching with black foil was installed.

On the black foil strip with a width of 1 m, two rows were made. The density was according to the scheme from experience. The establishment of the crop was carried out in autumn with sowing in September and planting in early November, according to the research plan.

After the establishment of the crop, the care works were: maintaining the constant moisture of the soil, destroying the weeds that appeared around the plants and ensuring the other vegetation factors. The harvests were made alternately, depending on the variety, the heads and the rosette of leaves, respectively.

RESULTS AND DISCUSSIONS

Table 1 shows the influence of variety on Chinese cabbage production. In this case, the witness of the experience was represented by the average of the experience. Compared to the control, Pak Choi did not reach the production level of the average experience, and the difference did not exceed the p 5% threshold, thus not being statistically assured. Of the three varieties, the Pe Tsai variety recorded a production increase of 14.3%. The difference with respect to the control was statistically positive, distinctly significant. The Tat soi registered only 90.6% of the control production. The difference from it was statistically negatively significant.

Table 1

Influence of variety on production

Variant	Absolute production Kg/m^2	Relativ producti on %	± Kg/m^2	Signifi cance
V0 (Ct)	3.79	100.0	0.00	-
V1	3.60	95.1	-0.19	-
V2	4.33	114.3	0.54	XX
V3	3.43	90.6	-0.36	0

LSD (p 5%) = 0.33
LSD (p 1%) = 0.54
LSD (p 0.1%) = 1.01

As for the influence of density on production, the density of the three varieties has a very small influence, compared to the control, which has a density of 80,000 plants per ha. The other two variants recorded higher yields than the control, but these were quite low, and were not statistically significant. We present the results in Table 2.

Table 2

Influence of density on production

Variant	Absolute production Kg/m^2	Relativ product ion %	± Kg/m^2	Signific ance
D1 (Ct)	3.66	100.0	0.00	-
D2	3.75	102.6	0.09	-
D3	3.97	108.5	0.31	-

LSD (p 5%) = 0.42
LSD (p 1%) = 0.59
LSD (p 0.1%) = 0.83

Table 3 shows the influence of density on variety, so cabbage yields differed. Density 1 and Pak choi represented the first control, and compared to this a lower density, had D2 V1, registering only 68.0% of the control production. The difference was statistically negatively very significant. In the case of D3, respectively 70,000 plants per ha, this variety obtained an even worse production, only 54.5% of the control production. The difference was statistically negatively very significant. As regards the influence of density on the Pe tsai variety, it recorded higher yields than the control. The best variety was D3 V2 which obtained 1.71 kg/sqm more than the control, and in this case, the difference was statistically positive very significant. There was a lower density in the D2 V2 variant, and a lower increase of 31.8%. The difference to the control was statistically positive, distinctly significant. As for the Tat soi variety, here too the density influenced the production. Thus, for the D2 V3 the production increase was 27.7%, and the difference compared to the control was statistically significantly positive. The D3 V3 variant achieved a production higher than the control by 1.44kg/sqm. The difference was statistically positive, very significant.

Tabel 3

Interaction of density to variaty

Variant	Absolute production Kg/m^2	%	Difference	Signific ance
D1V1 Ct	4.86	100.0	0.00	-
D2V1	3.31	68.0	-1.55	000
D3V1	2.65	54.5	-2.21	000
D1V2Ct	3.40	100.0	0.00	-
D2V2	4.49	131.8	1.08	xx
D3V2	5.11	150.1	1.71	xxx
D1V3Ct	2.70	100.0	0.00	-
D2V3	3.45	127.7	0.75	x
D3V3	4.14	153.3	1.44	xxx

LSD (p 5%) =0.72
LSD (p 1%) =1.01
LSD (p 0.1%) =1.43

Table 4 shows the interaction of variety at density, basically the influence of variety and density on Chinese cabbage production. As for the first density of 80,000 plants per ha, the Pak choi variety obtained 1.20 kg/sqm more than the control, which is represented by the control of the experiment. The difference was statistically positive, distinctly significant. In the case of the Pe tsai variety, at a density of 80,000 plants per ha, it obtained 0.25 kg/sqm less than the control. The difference, however, was not statistically ensured, because this value was below DL 5%. At the same density, the Tat soi obtained only 74% of the average experience. The difference was statistically significantly negative. At the second density of

60,000 plants per ha, only Pe tsai achieved a production increase of 19.7%.

The difference was statistically significantly positive. The other variants obtained productions below the experience average, but without exceeding the 5% threshold, so they were not statistically insured. The density of 70,000 plants per ha (D3) negatively influenced the production of the Pak choi variety.

This variant recorded only 66.7% of the average experience, the difference being statistically negatively significantly significant. This density positively influenced production at Pe tsai. Thus, in this variant, the increase in production was 28.8%, and the difference was statistically positive, distinctly significant. In the case of the V3 D3 variant, there was also a small increase in production, which, however, did not pass the 5% threshold.

Table 4

Interaction of variety to density

Variant	Absolute productionKg/m^2	%	Difference	Significance
V0D1 Mt	3.66	100.0	0.00	-
V1D1	4.86	132.9	1.20	xx
V2D1	3.40	93.1	-0.25	-
V3D1	2.70	74.0	-0.95	0
V0D2 Mt	3.75	100.0	0.00	-
V1D2	3.31	82.2	-0.44	-
V2D2	4.49	119.7	0.74	x
V3D3	3.45	92.1	-0.30	-
V0D3 Mt	3.97	100.0	0.00	-
V1D3	2.65	66.7	-1.32	00
V2D3	5.11	128.8	1.14	xx
V3D3	4.14	104.5	0.18	-

LSD (p 5%) = 0.67
LSD (p 1%) =0.97
LSD (p 0.1%) =1.47

CONCLUSIONS

The research carried out in the autumn of 2023, in an organically certified microfarm, located in the North-West of Romania com. Husasău de Tinca, regarding the influence of density and variety on Chinese cabbage production, highlighted several aspects, namely:

With a production of 4.33 kg/sqm variety Pe tsai obtained the highest production among the varieties studied;

The Tat soi was at the opposite pole, with the lowest production (3.43 kg/sqm), compared to the average experience;

Density had an insignificant influence on Chinese cabbage production;

The interaction of the two factors highlighted a positive influence in the case of the D3 V2 variant, with an absolute production of 5.11kg/sqm and a production increase of 50%;

With a lower absolute production, but with a higher production increase of 53.3%, the D3 V3 variant also stood out;

The lowest yields in the case of the denisted interaction in the variety were obtained at D3 V1 with an absolute production of 2.65 kg/sqm;

The interaction of variety at density highlighted the V2 D3 variant with 5.11kg/sqm absolute production;

The worst behavior in the case of variety-to-density interaction was obtained in the V1 D3 variant with an absolute production of 2.63 kg/sqm and 1.32 kg/sqm less than in the control;

Chinese cabbage is an increasingly sought-after vegetable, generating an increasing interest, year after year, from consumers.

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