SELECTION AND DEVELOPMENT OF WELSH ONION VARIETIES IN THE NORTH OF VIETNAM

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ABSTRACT

Welsh onion (*Alium fistulosum* L.) as the species is native to China, cultivated in many places and natural locations in Eurasia and North America. Welsh onions are one of the most widely used vegetables spices in the daily meals of people around the earth. From Autumn - winter crop 2017 to Autumn - winter crop 2018, the Fruit and Vegetable Research Institute conducted a research to select and evaluate 6 Welsh onion varieties, which are varieties (Jang Yoel, Green, Keuk Beun Keum Jang, HuK Keum Jang, Cheon chu Deapa) and Vietnam's Hanh dam variety (control). The results of testing in two seasons showed that the Welsh onion variety Huk Kuem Jang is a superior promising variety, well growing variety, resistant to main pests and diseases, gave a high yield over 60 tons/ha. Welsh onion variety Huk Kuem Jang was demonstrated at Ha Noi city and Hoa Binh province in the Autumn - Winter season of 2021 and Spring - Summer 2022 crop. The results determined that the Welsh onion variety Huk Keum Jang grew and developed quite stably and was suitable in two regions with different ecological conditions, with a plant weight of 350 - 400 gram/plant, total yield of more than 60 tons/ha and suitable for domestic consumption and export.

Keywords: *Korean welsh onion, green onion, Spring onion, long onion.*

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1. INTRODUCTION

Welsh onion (*Alium fistulosum* L.) is one of the vegetables spice belonging to the onion family (*Liliaceae*) [1]. Welsh onions are herbaceous perennials. In Vietnam, the annual planting area is about 36,000 hectares and the produce average is about 600,000 tons, welsh onions are mainly grown season in the Spring - Summer and Autumn - Winter crops, onions are usually grown in the Winter. Welsh onions are seasoning vegetables that, in addition to the usual nutritional ingredients such as vitamins A, B, C and mineral salts (iron, phosphorus, sulfur, flou, silicon, iodine,...) special substances, with special flavors that help the human body to prevent and tolerant some diseases, help to relax the spirit... have high nutritional and economic value; in particular, green onions also have high value in medicine [2]. In current production, welsh onion has become a vegetable with high economic efficiency in many production areas [3]. Welsh onion products can be used for eaten fresh, frozen or processed and dried with a many kind of products.

Currently, the export demand of Vietnam's agricultural products, including welsh onions, is very big market. Korean food companies are looking for materials to produce agricultural products such as onions, peppers, radishes, cabbage, potatoes, pumpkins, and cucumbers of Vietnam to supply to vietnam dometic market and the Korean community in Vietnam, simultaneously import to the Korea [4]. Within the agricultural research and development cooperation between the Vietnam Academy of Agricultural Sciences and the Korea Rural Development Agency, the identification of welsh onion vegetable species and

vegetable varieties with high adaptability to Vietnam's conditions is absolutely necessary. Not only solving the problem of providing a large amount of vegetables for export to earn foreign currency, the production of vegetables in general and welsh onions in particular but also helps to create jobs, increase incomes for Vietnamese farmers and contribute to management agencies as well as farmers organize production according to the scale of goods, achieving high economic value [5].

The annual vegetable area of the whole country in the past near 3 years has increased slightly from 975.0 thousand hectares in 2020 to 988.7 thousand hectares in 2022. Vegetable output in 2020 was nearly 18 million tons and in 2022 was 18.6 million tons. Compared to the same period, in the first 6 months of 2023, the vegetable area of the whole country decreased by 2%. In terms of varieties, there are 80 types of vegetables grown, of which nearly 30 main types of vegetables account for 80% of the area and output. The demand for vegetable seeds for the whole country is estimated at about 600 - 650 million USD/year; every year the whole country has to import about 500 million USD worth of vegetable seeds (especially cabbage, kohlrabi, welsh onion...), accounting for about 80 - 85% of the demand for seeds for production [6].

In order to the requirements of production, the selection of welsh onion varieties is being interested by domestic institutes, universities and research companies, choosing to good welsh onion varieties suitable to consumer, gave high yield, high quanlity, good resistance some main diseases.

2. MATERIALS AND METHODS

2.1. Materials

Evaluation trial was conducted on 6 Welsh onion varieties imported from Korea: Jang Yeol, Heuk Beung Keum Jang, Huk Keum Jang, Cheon chu Daepa, Green belt and Vietnam Green onion variety: Hanh dam (control variety).

2.2. Methods

Evaluation: Evaluation of growth characteristics, yield and pests and diseases of green onion varieties; trial production of promising varieties in different ecological regions.

-Basic trial: Seeds are sown in the nursery with 3 - 4 true leaves (35 - 40 days) and then transplanted into the experimental field. The experiment was arranged in fully randomized block design (RCBD) with 3 replications, the experimental plot area was $6 \times 1.4 = 8.4$ m^2. Total experiment area: 200 m^2 (including protecting area). Bed surface area was 70 cm, furrow wide was 20 - 30 cm, Seeds were grown 2 rows/bed. Distance between plants was 3 - 5 cm, distance between rows was 7 - 10 cm. Density was 50 - 60 plants/m^2 , fertilier compost were supplemented with 15.0 - 20.0 tons/ha, N 70 kg/ha, P_20_5 40 kg/ha, K_20 120 kg/ha and lime 500 kg/h.

- Production testing: Large - scale testing: Experimental layout is sequential, no replication. The area 0.1 - 0.2 ha/model.

The basic test and production test apply the technical process of Welsh onion production of the Fruit and Vegetable Research Institute (Favri) [7].

Data collection: Growth period (date of sowing, date of planting, harvesting, total growing time); agronomic characteristics of the plant (number of leaves, length, stem diameter...); yield and yield components (plant weight, yield/m^2, yield/plot, yield/ha); pests and diseases (monitor the level of late blight and leaf blight by scoring according to the guidelines of the World Vegetable Center (AVRDC))

Disease Rating scale:

+ Mark 0: No Symptom (High resistance).

+ Mark 1: Light 1 - 10% of infected leaf area infected (Resistance).

+ Mark 2: Average 11 - 25% of infected leaf area infected (Moderate resistance).

+ Mark 3: Heavy 26 - 50% of infected leaf area infected (Moderate susceptible).

+ Mark 4: Very heavy 51 - 75% of infected leaf area infected (Susceptible).

+ Mark 5: Serious 76 - 100% of infected leaf area infected (High susceptible).

Subscribe to the rate of viral infection by calculating the percent of plant damage:

$$\text{Disease} = \frac{\text{Number of damaged plants/plots}}{\text{Total number of plants/plots}} \times 100\%$$

Data processing and analytical methods

Evaluation of horticultural characteristics and rate of pests and diseases by the method of AVRDC. The data were subjected to an analysis of variance using IRRISTAT (5.0 version) software, and the significant mean separations were compared using $LSD_{0.05}$

Place and time of study

The experiment was arranged at the Fruit and Vegetable Research Institute from 2017 to 2019 with 2 crops season/year. Autumn - Winter crop 2017: Sown on September 5, 2017 and planting date on October 20, 2017. Autumn - Winter crop 2018 September 10, 2018 and planting date October 25, 2018.

Large - scale trials were conducted in Ha Noi city and Hoa Binh province in Autumn – Winter crop 2021 crop season and Spring - Summer crop 2022 crop season.

3. RESULTS AND DISCUSSION

3.1. Evaluated test results

Table1. Growth characteristics of Korean Welsh onion varieties in the Autumn - Winter crop 2017 season and Autumn - Winter crop 2018 season in Gia Lam district, Ha Noi city, Vietnam

No.	Name of variety	Plant height (cm)	No. of leaf (leaf)	No. of branch/ Plant	Stem diameter (cm)	Leaf color	Total grow period (day)
Autumn - Winter crop 2017							
1	Jang Yeol	70.46	5.86	1.00	2.38	Light green	120 - 150
2	Green belt	37.76	14.33	4.31	0.62	Dark green	90 -120
3	Heuk Beung Keum Jang	72.80	5.9	1.00	2.60	Light green	120 - 150
4	Huk Keum Jang	91.33	7.37	1.00	3.36	Light green	120 - 150
5	Cheon chu Daepa	74.40	6.03	1.00	2.43	Light green	120 - 150
6	Hanh dam (control)	53.86	14.30	5.61	1.33	Dark green	60 - 90
	$LSD_{0.05}$	*5.75*	*1.66*	*0.80*	*10.51*		
	CV (%)	*4.7*	*10.2*	*19.0*	*16.2*		
Autumn - Winter crop 2018							
1	Jang Yeol	70.13	5.53	1.00	2.46	Light green	120 - 150
2	Green belt	36.10	12.57	4.26	0.73	Dark green	90 -120
3	Heuk Beung Keum Jang	70.8	5.70	1.00	2.33	Light green	120 - 150
4	Huk Keum Jang	89.00	6.73	1.00	3.20	Light green	120 - 150
5	Cheon chu Daepa	73.93	5.86	1.00	2.60	Light green	120 - 150

6	Hanh dam (control)	*50.33*	*13.50*	*6.03*	*1.33*	Dark green	60 - 90
	$LSD_{0.05}$	*4.39*	*1.13*	*0.74*	*0.26*		
	CV (%)	*3.7*	*7.5*	*17.3*	*6.8*		

Table 2. Insect and disease infection on Welsh onion trial in the Autumn - Winter crop 2017 crop season and Autumn - Winter crop 2018 crop season in Gia Lam district, Ha Noi city, Vietnam

No.	Name of variety	*Botrylis squamosa* (mark)	*Peronospora schleidni* (mark)	Pseudomonas spp. (mark)	*Spodoptera exigua (Score)*
1	Jang Yeol	+	+	+	3
2	Green belt	+	+	+	-
3	Heuk Beung Keum Jang	+	+	+	4
4	Huk Keum Jang	+	-	-	-
5	Cheon chu Daepa	+	+	+	1
6	Hanh dam (control)	++	+	++	3

Note: (-) no symptom (high resistance), (+) light symptom (resistance)., (++) Average (Moderate resistance).

The results of testing 6 varieties in the Autumn - Winter crop 2017 showed that the growth period of Korean varieties is longer than that of Vietnamese varieties, with a total growth time of 120 days after sowing. The number of leaves/plant was different between treatments. Based on the number of branches of the varieties participating in the experiment, welsh onion has 2 forms: Cluster form and tree form. The bulbous varieties have the ability to produce many branches, but have small stem diameter and low plant height. The tree form is not branched but has a large tree height and trunk diameter. For cultivars with a cluster form, the leaves are numerous and the leaves are smaller and weaker than those of the tree. After evaluating growth characteristics, promising onion varieties were identified as: Huk Keum Jang, Heuk Beung Keum Jang and Jang Yeol. These varieties were continued to be tested in the next crops in the 2018 Autumn - Winter crop season, also giving good results.

Pests and diseases infection of onions: In the Autumn - Winter crop, the weather is dry and cold, so the situation of pests and diseases is less developed. Among the promising varieties, Korean Welsh onion varieties are less diseaser (mark 1) than Vietnamese Welsh onion (mark 2).

The results in 2 crop seasons showed that some major pests and diseases on onion such as dry leaf (*Botrytis squamosa*) disease. This disease usually appears when the plant is still young and it affects the growth and development, causing the leaves to not grow and is the cause of a sharp decrease in yield. Among the varieties participating in the experiment, control variety Hanh dam was infected at (++) level, while Korean varieties were infected at a mild level. Huk Keum Jang variety shows resistance to some diseases

such as downy mildew (*Peronospora schleiden*), stem gray rot...

The yield through the two trialseasons showed that the Korean Welsh onion varieties had a superior yield compared to the Hanh dam variety of Vietnam (control). The variety with the highest individual yield and yield per hectare was the variety Huk Keum Jang with 105.66 tons/ha in the Autumn - Winter crop 2017 , followed by the variety Cheon chu Daepa 88.53 tons/ha and Heuk Beung Keum Jang with a yield gave 86.33 tons/ha. The Hanh dam (control) is lowest yield just gave 24.86 tons/ha. In the Autumn - Winter crop 2018 , these varieties also achieved high yields, with the Huk Keum Jang variety reaching 95.80 tons/ha, Cheon chu Daepa 87.16 tons/ha and the Heuk Beung Keum Jang variety yielding 81.73 tons/ha. The Vietnam Hanh dam (control) has also lowest yield in 2018 gave 25.50 tons/ha.

Table 3. Yield and yield components of Welsh onion varieties trial in the experiment in Autumn - Winter 2017 season and Autumn - Winter 2018 season

No.	Name of variety	Yield per plant (gam/plant)	Yield per m^2 (kg/m^2)	Total Yield (ton/ha)
Autumn - Winter 2017				
1	Jang Yeol	270.46	8.37	83.73
2	Green belt	25.33	1.98	19.86
3	Heuk Beung Keum Jang	341.66	8.63	86.33
4	Huk Keum Jang	389.133	10.56	105.66
5	Cheon chu Daepa	286.23	8.85	88.53
6	Hanh dam (control)	126.57	2.48	24.86
	$LSD_{0.05}$	*34.44*	*1.14*	*11.45*
	CV (%)	*7.9*	*9.2*	*9.2*
Autumn - Winter 2018				
	Jang Yeol	264.86	8.00	80.00
2	Green belt	25.03	1.92	19.20
3	Heuk Beung Keum Jang	328.86	8.17	81.73
4	Huk Keum Jang	357.100	9.58	95.80
5	Cheon chu Daepa	289.633	8.71	87.16
6	Hanh dam (control)	123.43	2.55	25.5
	$LSD_{0.05}$	*19.63*	*0.87*	*8.7*
	CV (%)	*4.7*	*7.5*	*7.5*

Figure 1. Korean Welsh onion Huk Kuem Jang and Vietnamese green onion Hanh dam

3.2. Demonstration trial results

Throught the evaluated of welsh onion results of previous years, in the Autumn - Winter 2021 and Spring - Summer 2022. The promising welsh onion variety Huk Keum Jang has been trial for production crop season in different ecological regions in Gia Lam district, Ha Noi city and and Tan Lac district, Hoa Binh province gave very good results, highly appreciated by the farmers for growth well, resistance to main pests and diseases, high yield and good quality.

Table 4. Economic efficiencies of Welsh onion demonstrationsin Winter season of 2021- Spring season of 2022 in Ha Noi city and Hoa Binh province, Vietnam

No.	Name of variety	Yield (ton/ ha)	Price (1.000 VND/kg)	Gross revenue (Millionaire VND/ha)	Production cost (Millionaire VND/ha)	Net benefit (Millionaire VND/ha)
Winter crop 2021 - Spring crop 2022 in Gia Lam district, Ha Noi city						
1	Huk Keum Jang	70.12	12.000	841.2	150.0	691.2
	Hanh dam (control)	19.27	20.000	385.4	180.0	205.4
Winter crop 2021 - Spring crop 2022 in Tan Lac district, Hoa Binh province						
2	Huk Keum Jang	65.0	12.000	780.0	150.0	630.0
	Hanh dam (control)	18.0	20.000	360.0	180.0	180.0

The yield of the Welsh onion variety Huk Keum Jang is stable in different ecological regions. Productivity in Gia Lam district, Ha Noi city reached 70.12 tons/ha, in Hoa Binh province reached 65.0 tons/ha. This result is similar to the previous trial results. With the average selling price of 12,000 - 15,000 VND/kg, the income from Huk Keum Jang Welsh onion reached 630 - 691.2 million VND/ha, is increase income 300% higher than the Hanh dam Vietnam Welsh onion variety (control).

In summary, through evaluated experiments, basic trial and production trials, Welsh onion Huk Keum Jang variety has been determined to have many good characteristics and is the best variety among the tested varieties.

* Characteristics of Huk Keum Jang variety

- Origin: The seed of Asia seeds Company, Korea.

- Growth time 120 - 150 days.

- The weight of the tree is 300 - 450 gram; white and long stem; large and strong leaves, few light green leaves; tree without branches... The Welsh onion has a high stem/leaf ratio, light aroma, long storage time, good resistance to pests and diseases in field conditions. The yield is 60.0 - 70.0 tons/ha.

- Cons: Green onions have very big and large leaves; Vietnamese consumers are not much used to them.

Figure 2. Huk Keum Jang welsh onion demonstration field in Gia Lam district, Ha Noi city

4. CONCLUSIONS

All the Korean Welsh onion varieties have the ability to adapt to the ecological conditions of the trial and trial production areas of Vietnam, shown in agronomic characteristics and high yield, good quality, resistance to insects and diseases. Huk Keum Jang variety is a promising variety has a plant weight of 350 - 400 gram; long white stem; stem diameter, light green leaves; unbranched. The variety has a high ratio of stem/leaf, light aroma and longtime storage and high yield with 105.96 tons/ha (2017) and 95.80 tons/ha. The Hanh dam varieties (control) obtained 24.86 tons/ha (2017 Autumn - Winter crop season) and 25.50 tons/ha (2018 Autumn – Winter crop).

The demonstration in two lacation the Huk Keum Jang variety is growing well, resistant to pests and diseases well in field conditions. The yield is 60 - 70 tons/ha.

The income from Huk Keum Jang Welsh onion reached 630.0 - 691.2 million VND/ha, is increase income 300% higher than the Hanh dam Vietnam welsh onion variety (control).

Through experiment trials and trial productions in two localities, this welsh onion Huk Keum Jang variety opens up the possibility of production on a commodity scale, supply to Vietnam domestic demand and export demand to Korea, japan...

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