ĐẠI HỌC HUẾ
HUE UNIVERSITY

TẠP CHÍ KHOA HỌC
Journal of Science

Chuyên san
Nông Nghiệp, Sinh học và Y Dược

Agriculture, Biology, Medicine and Pharmacy Issue

ISSN 1859-1388

Tập/Volume 98
Số/Number 10, 2014

Journal of Science – Hue University
ISSN 1859-1388
Vol. 98, No. 10, 2014

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Journal of Science – Hue University
ISSN 1859-1388
Vol. 98, No. 10, 2014, PP. 75-91

STUDY ON SPONGE GOURD (*Luffa cylindrica*) GERMPLASM FROM SPRING TO SUMMER 2014 AT GIA LAM, HA NOI

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Abstract. In this study, fourty-nine sponge gourd (Luffa cylindrica) varieties were evaluated on agronomic characteristics and yield components from spring to summer 2014 at Gia Lam, Ha Noi. The purpose of this study was to identify varieties that have high yield, good quality and resistance to insects and diseases for breeding programmes. The experiment was laid out in a CRD without replication. The plot size was 8.6m2 with 6 plants. The results showed that A16, A17, B1, B2, B3, B4, B10, B16, B18, B19, B27, B29 and B30 grown well under Ha Noi condition. Fruits of A16, B3, B10 and B22 have good quality (aromatic and sticky after being cooked). Fruits of A12, A13, B1, B3, B24, and B29 had brix greater than five. Yield of three varieties such as B16, B27 and B30 was higher than control check. These varieties can be used in sponge gourd breeding programmes.

Keywords: Sponge gourd, Loofah, Luffa cylindrica, Cucurbitaceae, fragrant, fibers

1 Introduction

Smooth Luffa (Luffa cylindrica) belonging to gourd family (Cucurbitaceae), also known as the "Muop ta" or "muop goi", is one of the popular vegetables in Vietnam. Smooth Luffa is cultivated in the tropics and subtropics of Asia. Luffa supply many nutrients, vitamins and many therapeutic effects that have been scientifically proven. Luffa fruits contain high levels of minerals (Mg, Ca, Na, Fe, Cu, ...) (Dairo et al., 2007). In addition, Luffa also contains vitamin B that helps prevent aging, vitamin C whitening, etc,... Nowadays, Luffa plants are considered as functional foods and important medicinal plants. Smooth Luffais is more preferred than the other types of Luffa because it is sweet and aromatic. Different parts of Luffa plant can be used to cure diseases. For example, luffa roots can be used to treat rhinitis, sinusitis; luffa wire can be used to treat back pain, cough; seeds for the treatment of productive cough, roundworm, loofah leaves can be used to treat sore muscles, luffa fruit cures swollen foot pain, snake bites, seizures, tetanus, and stimulates milk secretion in mothers who are breastfeeding... (Partap et al., 2012). In China, Smooth Luffa are used in traditional medicine to treat a number of diseases such as digestion, antipyretic, and anti-fatigue because its extract has antioxidant properties (Du and Cui, 2007). Besides, loofah component of cellulose (60%), hemixenlulose (30%) and wood (10%) (Rowell et al, 2002; Mazali

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Submitted: July 13, 2014; Revised: Oct 04, 2014; Accepted: Dec 12, 2014.

and Alves, 2005), therefore it is used to study in the manufacture membranes for filtering heavy metals (Oboh et al, 2011). Thus, Smooth Luffa has potential for the processing industry. If the vegetable industry of Vietnam is developed in the future, processing zones will require large amounts of Luffa. However, growing area of Smooth Luffa in Vietnam is currently limited; varieties being planted are local varieties, and famers keep the seed for next sowing season by themselves. This made the local variety having good quality such as aroma degraded and adulterated because of pollenating free. To increase production area, breeding new Luffa variety with high yield, good quality, and disease resistance is needed. In this study, we conducted an experiment on "Study on sponge gourd (luffa cylindrica) germplasm in spring-summer 2014 at Gia Lam, Ha Noi" with aim at finding good varieties that have aroma, high yield, pest resistance for breeding program.

2 Materials and methods

2.1 Materials

In this study, a total of49 accessions (Table 1) obtained from Plant Genetice Resource of Viet Nam were used.

Table 1. List of Sponge gourdgermplasm used in the experiment

No.	Accession name	License number	Common name	No.	Accession name	License number	Common name
1	A1	GBVN007760	Sponge Gourd long-fruit	26	B6	GBVN005326	Sponge Gourd
2	A2	GBVN007766	Sponge Gourd	27	B7	GBVN005331	Sponge Gourd Shape-1
3	A3	GBVN007767	Sponge Gourd-Shape-1	28	B8	GBVN005332	Trang Dinh
4	A4	GBVN007768	Sponge Gourd	29	B9	GBVN005333	Sponge Gourd
5	A5	GBVN007769	Sponge Gourd	30	B10	GBVN005336	Sponge Gourd
6	A6	GBVN007773	Sponge Gourd	31	B12	GBVN005346	Sponge Gourd Shap-1
7	A7	GBVN007776	Sponge Gourd	32	B13	GBVN005347	Sponge Gourd

8	A10	GBVN008861	Sponge Gourd	33	B14	GBVN005348	Sponge Gourd
9	A11	GBVN008864	Sponge Gourd	34	B15	GBVN06568	Sponge Gourd
10	A12	GBVN008866	Sponge Gourd	35	B16	GBVN006574	Sponge Gourd
11	A13	GBVN009754	Sponge Gourd	36	B17	GBVN006576	Sponge Gourd
12	A15	GBVN012229	Sponge Gourd Shape-2	37	B18	GBVN006578	Sponge Gourd
13	A16	GBVN012230	Sponge Gourd-Shape-2	38	B19	GBVN006721	Sponge Gourd
14	A17	GBVN012233	Sponge Gourd Shape-2	39	B21	GBVN006735	Sponge Gourd
15	A18	GBVN012235	Sponge Gourd Shape-2	40	B22	GBVN006737	Sponge Gourd
16	A19	GBVN012242	Sticky Luffa	41	B23	GBVN006778	Sponge Gourd
17	A20	GBVN005324	Yellow Luffa	42	B24	GBVN006779	Nho Quan
18	A25	GBVN005332	Trang Dinh	43	B25	GBVN006900	Sponge Gourd
19	A29	GBVN005351	Buffalo's Horn Luffa	44	B26	GBVN006901	Sponge Gourd
20	A30	GBVN 006567	Sponge Gourd long-fruit	45	B27	GBVN006902	Sponge Gourd
21	B1	GBVN003694	Sponge Gourd	46	B28	GBVN006903	Sponge Gourd
22	B2	GBVN003695	Sponge Gourd	47	B29	GBVN006904	Sponge Gourd
23	B3	GBVN003696	Sponge Gourd	48	B30	GBVN006906	Sponge Gourd
24	B4	GBVN003717	Sponge Gourd	49	Control check		Local Sponge Gourd
25	B5	GBVN003834	Sponge Gourd				

2.2 Methods

- The experiment focused on evaluation growth ability and identification of promising varieties having good characteristics.

- The experiment was conducted in an alluvial soil field at Fruit and Vegetable Research Institute, Ha Noi.

- The experiment was laid out in a Complete Random Design (CRD) without replication, included 49 accessions corresponding to 49 plots (8.6 m^2/plot and 6 plants/plot).

- The experiment was conducted from February to May, 2014.

- The cultivated technique was based on National technical regulations of QCVN 2013 DUS of Angel Loofah.

- The experiment evaluated morphological traits, structure, growth and development ability, resistance to diseases and pests, yield components and yield, and fruit quality.

- Data was analyzed by Excel program.

3 Results and discussion

3.1 Growth and development periods of Sponge gourd germplasm

Study on growth period of Sponge gourd has influenced on assessment of rare ripe or over-ripe and is a reason to dispose logical structure of cultivation. This is premise to select variety suitable for cultivated and surrounding conditions of each production area. Time to finish growth and development periods is show in Table 2.

Timing from germination to appearance of true leaves changed from 17 to 21 days, most accessions have true leaves on 17th after sprouting and some accessions such as A2 and A16 were later (21 days). Timing from germination to ramification changed from 43 to 51 days. The earliest accession was A30 (43 days), the latest accessions were B1, B23 and B12 (56 days). Timing from planting to appearance of male flower changed from 43 to 62 days, some accessions were flowering earlier such as A12, A15 and B16. Timing from planting to appearance of female flower changed from 49 to 69 days, some accessions were flowering earlier such as A10, A14 and A20. There is difference about timing from sprouting to the first harvesting in all of accessions. This period changed from 72 to 87 days, some early harvested accession such as B16 and B27.

Table 2. Timing through growth and development periods of Sponge gourd germplasm (day)

No.	Accession name	From sprouting to... (day)					No.	Accession name	From sprouting to... (day)				
		True leaves	Ramification	Male flower	Female flower	1st harvesting			True leaves	Ramification	Male flower	Female flower	1st harvesting
1	A1	17	50	55	68	84	26	B6	17	54	62	62	79
2	A2	21	50	60	68	87	27	B7	17	54	62	65	86
3	A3	17	45	51	64	86	28	B8	19	54	60	65	79
4	A4	17	45	51	68	86	29	B9	17	46	54	62	79
5	A5	19	45	60	68	86	30	B10	17	54	54	65	83
6	A6	19	47	55	59	81	31	B12	19	56	55	65	79
7	A7	17	45	51	59	80	32	B13	17	54	54	62	77
8	A10	17	47	49	51	87	33	B14	17	54	60	57	86
9	A11	17	47	49	68	77	34	B15	17	54	55	62	87
10	A12	17	47	43	68	77	35	B16	17	54	46	56	72
11	A13	17	47	51	68	87	36	B17	19	54	60	62	79
12	A15	19	45	43	49	82	37	B18	17	54	55	62	80
13	A16	21	51	57	59	77	38	B19	17	46	62	67	83
14	A17	17	50	55	64	80	39	B21	17	46	55	65	79
15	A18	17	50	55	59	87	40	B22	17	54	60	69	87
16	A19	17	45	53	59	77	41	B23	19	56	62	69	82
17	A20	17	45	55	49	87	42	B24	17	54	55	62	83
18	A25	17	45	55	59	80	43	B25	17	54	55	62	79
19	A29	17	50	50	59	77	44	B26	17	54	55	65	86
20	A30	17	43	53	59	86	45	B27	17	46	54	62	72
21	B1	17	56	55	62	80	46	B28	17	45	55	55	75
22	B2	19	54	60	67	77	47	B29	17	45	56	61	87
23	B3	17	54	60	62	77	48	B30	17	45	55	55	75
24	B4	17	54	55	62	80	49	Control check	17	50	57	60	80
25	B5	17	54	55	62	80							

3.2 Ability of growth and development of Sponge gourd germplasm

The results were recorded in Table 3. Total of the 1st branch changed from 6 to 10.4 branches. Some accession such as A14, A16 and B16 had highest number of branch (approximate 10 branches) and some accessions such as A3, A8, A11, A17, B3 and B8 had lowest number of branches (approximate 6 branches).

The leaf area were different depend on variety and cultivated conditions and changed from 152 – 526 cm^2. Control check had the largest leaf area (526 cm^2), next was B30 (520 cm^2) and the lowest leaf area belong to B4 (152 cm^2).

The number of node had the first flower changed from 6.4 to 15.8. A11 accession flowered at the lowest node (6.4th node) and accession A5 flowered at the highest node (15.8th node).

The length of internode changed from 11.5 to 25.0cm. A11 accession had lowest length of internode (11.5cm) and B16 had highest length of internode (25.0cm).

Table 3. Ability of growth and development of Sponge gourd germplasm

No.	Accession name	Total the 1st branch/plant	Leaf area (cm2)	Number of node has the first flower (node)	Length of internode (cm)	No.	Accession name	Total the 1st branch/plant	Leaf area (cm2)	Number of node has the first flower (node)	Length of internode(cm)
1	A1	7.6 ± 1.7	340	11.4 ± 1.1	13.6 ± 1.6	26	B6	8.8 ± 1.5	265.5	9.8 ± 0.8	13.4 ± 1.7
2	A2	7.6 ± 1.3	366.4	13.2 ± 2.3	14.2 ± 1.4	27	B7	9.8 ± 1.5	163.3	9.6 ± 2.3	14.6 ± 2.0
3	A3	6.6 ± 1.8	361.6	11.4 ± 3.2	14.1 ± 2.2	28	B8	6.0 ± 0.7	160.4	9.8 ± 3.4	13.2 ± 1.3
4	A4	9.0 ± 0.7	363.3	9.6 ± 2.4	14.3 ± 1.1	29	B9	8.0 ± 1.6	224.5	10.2 ± 2.6	15.7 ± 1.6
5	A5	8.2 ± 1.6	358.1	15.8 ± 3.1	13.5 ± 1.0	30	B10	8.8 ± 3.3	221.3	7.4 ± 2.3	14.4 ± 2.0
6	A6	8.8 ± 1.5	318.1	10.4 ± 0.9	15.3 ± 1.5	31	B12	9.2 ± 0.8	222	13.6 ± 3.0	18.3 ± 2.1
7	A7	9.8 ± 1.5	476.1	11.6 ± 1.7	14.4 ± 2.0	32	B13	9.6 ± 1.8	203.6	11.2 ± 1.3	18.0 ± 2.3

8	A10	8.8 ± 3.3	290.8	7.6 ± 1.1	13.7 ± 2.0	33	B14	10.0 ± 1.0	160	14.2 ± 4.0	15.8 ± 1.6
9	A11	6.2 ± 0.8	380.3	6.4 ± 1.3	11.5 ± 1.3	34	B15	8.0 ± 2.0	145.7	11.6 ± 2.4	15.5 ± 2.8
10	A12	9.2 ± 0.8	349.9	9.8 ± 1.6	15.6 ± 1.6	35	B16	10.4 ± 1.1	170.7	7.6 ± 1.5	25.0 ± 1.9
11	A13	9.6 ± 1.8	306.2	8.0 ± 1.0	13.5 ± 1.6	36	B17	6.2 ± 0.8	175.8	10.0 ± 1.2	15.3 ± 1.5
12	A15	8.0 ± 2.0	377.6	7.2 ± 0.8	13.9 ± 1.3	37	B18	8.2 ± 0.8	244.5	11.8 ± 2.3	21.2 ± 2.4
13	A16	10.4 ± 1.1	404.2	10.0 ± 2.9	14.0 ± 1.5	38	B19	8.6 ± 0.9	191.4	11.6 ± 1.9	20.3 ± 1.6
14	A17	6.2 ± 0.8	288.5	10.4 ± 2.5	14.4 ± 1.4	39	B21	8.4 ± 1.8	350.6	10.4 ± 1.7	16.8 ± 2.7
15	A18	8.2 ± 0.8	249.6	8.0 ± 1.6	13.3 ± 1.5	40	B22	8.8 ± 2.2	217.3	8.2 ± 1.9	14.4 ± 2.9
16	A19	8.6 ± 0.9	280	9.6 ± 1.5	15.2 ± 1.1	41	B23	7.8 ± 1.6	210.8	11.6 ± 4.3	17.9 ± 1.5
17	A20	7.6 ± 2.1	267.5	8.6 ± 2.1	14.6 ± 1.5	42	B24	8.8 ± 1.3	177.8	7.6 ± 1.5	18.4 ± 1.7
18	A25	8.8 ± 2.2	353	7.8 ± 0.4	15.1 ± 1.2	43	B25	8.4 ± 2.5	266.7	7.6 ± 3.6	17.1 ± 1.8
19	A29	7.8 ± 1.6	447	8.6 ± 1.5	13.3 ± 1.5	44	B26	7.4 ± 1.1	325.1	7.6 ± 2.7	18.1 ± 1.5
20	A30	8.8 ± 1.3	368.4	9.0 ± 1.4	15.9 ± 1.9	45	B27	8.8 ± 3.0	330.9	7.4 ± 1.7	19.2 ± 1.1
21	B1	7.6 ± 1.7	297.3	12.2 ± 3.1	14.4 ± 0.8	46	B28	8.4 ± 2.5	321	13.8 ± 3.8	15.9 ± 1.3
22	B2	7.6 ± 1.3	163.3	13.6 ± 1.1	15.9 ± 3.1	47	B29	7.4 ± 1.1	431	13.6 ± 3.9	17.4 ± 1.0
23	B3	6.6 ± 1.8	180.5	13.0 ± 1.7	14.3 ± 1.6	48	B30	8.8 ± 3.0	520.5	6.4 ± 1.1	18.7 ± 1.8
24	B4	9.0 ± 0.7	152.9	9.0 ± 1.4	14.2 ± 1.5	49	Control check	7.2 ± 0.8	526.5	7.6 ± 2.1	16.2 ± 1.4
25	B5	8.2 ± 1.6	210.8	12.4 ± 3.6	15.1 ± 1.5						

3.3 Morphological traits of Sponge gourd germplasm

Study on morphological traits will help to assess genetic diversity. The results showed that all 49 accessions are good material resources for futherbreeding programme. Each trait was divided into groups corresponding to different expression.

+ Leave color: Green color group included 13 accessions which are A1, A4, A5, A10, A15, A16, A19, B30, B14, B17, B21 and B23, light green color group included 8 accessions which are A2, A3, A7, A20, B5, B7, B12 and B13, and dark green color group included remaining accessions.

+ Leaf shape and leaf margin: Renal group included A1, A7, A12, A16, A17, A19, A25, A29, A30, B4, B5, B6, B7, B8, B10, B12, B14, B17, B22, B26 and control check; circle group included A2, A3, A4, A5, A6, A10, A11, A13, A15, A18, A20, B1, B2, B3, B9, B1, B15, B16, B18, B19, B21, B23, B24, B25, B27, B28, B29 and B30; and all the remains was serrated leaves.

+ Depth of lobing: Absent lobe group included 12 accessions (A3, A7, A12, A30, B2, B4, B6, B15, B19, B21, B22 and B24), medium lobe group included 7 accessions (B1, B10, B12, B13, B14, B18 and B23) and all the remains belong to shallow lobe group.

+ Stem transactional shape: All of accessions had angular stem transactional shape.

+ Peduncle transactional shape: All accessions had rounded penduncle transactional shape.

+ Stem-end fruit shape: point group included 20 accessions (A1, A2, A3, A4, A5, A11, A13, A18, A19, A25, A30, B3, B9, B13, B14, B17, B21, B23, B28 and B29) and round group included the remaining accessions.

+ Blossom-end fruit shape: round group included 16 accessions (A6, A12, A17, B1, B6, B7, B10, B12, B14, B15, B19, B24, B25, B26, B27, B29) and all the remains belong to point group.

+ Fruit shape: eliptical group had 10 accessions (A3, A7, A11, B2, B3, B6, B13, B19, B22, B28), plongate elliptical group had 11 accessions (A6, A17, A20, A25, B4, B8, B10, B25, B27, B30, and control check) and all the remains belong to elongate slim group.

+ Fruit color: dark green group included 11 accessions (A16, A18, A25, A29, A30, B8, B12, B15, B19, B22 and B29), light green group included 21 accessions (A4, A5, A7, A11, A13, A15, A17, A19, A20, B1, B6, B7, B9, B13, B14, B18, B27, B28, B30 and ĐI³) and the remains belonged to green group.

+ Nerve fruit color: green group included 19 accessions (A5, A2, A13, A15, A17, A19, B1, B2, B3, B4, B5, B6, B10, B16, B17, B2, B26, B28 andcontrol check), light green group included 9 accessions (A7, A11, B7, B9, B13, B14, B18, B21 and B27) and the remains belonged to dark green group.

+ Flexure of fruit: Almost accessions hadless flexurefruit, some accessions had medium flexure fruit such as A25, B3, B4, B16, B17, B19, and B28; only fruits of B10 were more flexure.

3.4 Yield components and yield

Fruiting rate changed from 6.7% to 29.5%, B10 accession had highest fruiting rate (29.5 %) and lowest fruiting rate was A18 (6.7%).

An average number of fruits per plant and medium weight of fruit are essential elements of yield component. Number of fruit per plant depends on ability of accumulate nutrients, surrounding conditions, care and nutrient regimes. An average number of fruits per plant changed from 1.2 to 5.4. Control check had the highest average number of fruits.

Fruit weight has immediate influence on yield. A medium weight fruit changed from 212g to 386g. Accession B25 had lowest average fruit weight (212g) and A20 had highest average fruit weight (386g).

Theoretic yield changed from 2.7 to 11.2 ton/ha. Control check had the highest theoretic yield (11.2 ton/ha) and B25 had the lowest theoretic yield (2.7 ton/ha).

Yield reflected adaptable ability of varieties with cultivated and surrounded conditions and were the results of growth and development process at particular condition. Yields changed from 1.3 to 5.5 ton/ha. Accession B25 had lowest yield (1.3 ton/ha) and B30 had highest yield (5.5 ton/ha).

Table 4. Yield components and yield

No.	Accession name	Fruiting rate (%)	Average number of fruit/plant (fruit)	Medium weight of fruit (g) $\overline{X} \pm SD$	Yield (ton/ha)	Theoretic yield (ton/ha)	No.	Accession name	Fruiting rate (%)	Average number of fruit/	Medium weight of fruit (g) $\overline{X} \pm SD$	Yield (ton/ha)	Theoretic yield (ton/ha)
1	A1	8.3	1.8	256.0 ± 97	1.5	3.2	**26**	B6	14.1	2.6	296.7 ± 69.8	2.3	5.4

11	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**
A13	A12	A11	A10	A7	A6	A5	A4	A3	A2
9.6	10.3	10.7	10.3	11.5	6.9	11	13.8	16.9	13.5
1.8	2	2.2	2	2.6	1.4	2	2.4	2.8	2.4
298.0 ± 41.5	320.0 ± 28.3	248.0 ± 67.2	296.0 ± 53.7	304.0 ± 95.3	290.0 ± 68.6	276.0 ± 73.7	284.0 ± 32.9	236.0 ± 49.7	244.0 ± 38.4
1.7	1.9	1.4	1.7	2.2	1.7	1.6	2	1.4	1.4
3.8	4.5	3.8	4.1	5.5	2.8	3.9	4.8	4.6	4.1
36	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**
B17	B16	B15	B14	B13	B12	B10	B9	B8	B7
13.8	17.9	14.3	15.7	11	11.4	29.5	11.2	13.6	10.9
2.4	3.4	2.2	2.2	2	2	3.6	2.6	3	2.8
260.0 ± 37.4	294.4 ± 90.2	288.0 ± 54.0	348.0 ± 50.2	256.0 ± 76.7	236.0 ± 38.5	273.3 ± 82.6	264.0 ± 69.9	235.0 ± 44.6	238.0 ± 50.2
1.5	4.4	1.7	2	1.8	1.4	2.1	1.7	1.5	1.5
4.4	7	4.4	5.4	3.6	3.3	6.9	4.8	4.9	4.7

21	**20**	**19**	**18**	**17**	**16**	**15**	**14**	**13**	**12**
B1	A30	A29	A25	A20	A19	A18	A17	A16	A15
22.7	11.6	19.2	11	11.3	16.7	6.7	23	14.9	14
4	3.4	3.8	2.2	1.8	3.2	1.2	4.6	2.6	2.4
294.3 ± 82.2	292.0 ± 11.0	270.0 ± 43.4	296.0 ± 57.3	386.0 ± 24.1	256.0 ± 82.9	330.0 ± 29.2	242.0 ± 45.2	333.0 ± 62.8	302.0 ± 22.8
3.1	1.7	1.9	1.7	2.2	1.5	2	2.5	2.3	1.8
8.2	6.9	7.2	4.6	4.9	5.7	2.8	7.8	6.1	5.1
46	**45**	**44**	**43**	**42**	**41**	**40**	**39**	**38**	**37**
B28	B27	B26	B25	B24	B23	B22	B21	B19	B18
17.4	15.8	8.4	8.4	11.1	11.2	10.1	7.3	13.5	14.5
3	3.2	1.8	1.8	1.6	2	1.6	1.6	2.8	3.6
263.0± 48.2	302.0 ± 42.6	248.0 ± 33.5	212.0 ± 61.0	264.0 ± 43.4	240.0 ± 42.4	274.0 ± 34.4	252.0 ± 79.5	333.8 ± 74.6	297.5 ± 64.5
2.1	4.3	1.4	1.3	1.9	1.4	1.6	1.7	4	3.7
5.5	6.8	3.1	2.7	3	3.4	3.1	2.8	6.5	7.5

22	B2	15.9	4.2	316 ± 59.0	2.2	9.3	47	B29	16.7	3	330.0 ± 63.3	1.8	6.5
23	B3	13.5	3.6	283.3 ± 46.3	2.9	7.1	48	B30	21.4	4.2	294.0 ± 75.8	5.5	8.6
24	B4	18.3	4	328.0 ± 50.2	2.2	9.2	49	Control	19.7	5.4	296.7 ± 34.9	4.1	11.2
25	B5	11.3	1.8	282.0 ± 36.3	1.6	3.6							

3.5. Fruit quality traits

Solid flesh: This character gives good appetite when served. Fruits of some accessions had solid flesh such as A3, A4, A5, A6, A7, A10, A15, A17, A18, A19, A29, A30, B6, B9, B12, B15, B19, B24, B27, B29 and B30. All the remains had flesh or little solid.

Flesh aroma: At raw and cooked state, each accession expressed different levels of aroma. After being cooked, fruits of some accessions such as A16, B10, B22 and B30 still had aroma. This is a valuable fruit trait.

Stickiness: Stickiness is one of characteristics that make food more tasty. Sticky character depends on varieties. Some accessions such as A2, A4, A6, A7, A13, A15, A16, A20, A29, B9, B14, B21, B24, B28 and B29 had sticky trait.

Brix: The results in table 5 show that Brix was different among accessions. Brix changed from 3.4 to 5.6. Some accessions such as B29, A13, A12, B3 and B24 had high Brix (5 – 5.2) and some accessions such as A29, B5, and B27 had low Brix (3.4-3.6).

Table 5. Quality fruit traits of Sponge gourd germplasm

No.	Accession name	Solid flesh	Level of aroma at raw state	Level of aroma at cooked state	Sticky level	Brix
1	A1	Little solid	Little fragrance	Non-fragrant	Little sticky	4.0
2	A2	Little solid	Non-fragrant	Non-fragrant	Sticky	4.8

3	A3	Solid	Non-fragrant	Non-fragrant	Little sticky	4.2
4	A4	Solid	Little fragrance	Non-fragrant	Sticky	4.0
5	A5	Solid	Non-fragrant	Non-fragrant	Little sticky	4.2
6	A6	Solid	Non-fragrant	Non-fragrant	Sticky	4.5
7	A7	Solid	Little fragrance	Little fragrance	Sticky	4.3
8	A10	Solid	Little fragrance	Non-fragrant	Little sticky	3.9
9	A11	Spongy	Non-fragrant	Non-fragrant	Little sticky	4.0
10	A12	Spongy	Non-fragrant	Non-fragrant	Little sticky	5.0
11	A13	Solid	Little fragrance	Non-fragrant	Sticky	5.2
12	A15	Solid	Non-fragrant	Non-fragrant	Sticky	4.2
13	A16	Spongy	Little fragrance	Fragrant	Sticky	4.2
14	A17	Solid	Fragrant	Little fragrance	Little sticky	4.1
15	A18	Solid	Non-fragrant	Non-fragrant	Sticky	4.2
16	A19	Solid	Little fragrance	Little fragrance	Little sticky	4.1
17	A20	Little solid	Little fragrance	Non-fragrant	Sticky	4.2
18	A25	Spongy	Little fragrance	Non-fragrant	Little sticky	4.1
19	A29	Spongy	Little fragrance	Non-fragrant	Sticky	3.6
20	A30	Solid	Non-fragrant	Non-fragrant	Little sticky	3.9
21	B1	Little solid	Non-fragrant	Non-fragrant	Little sticky	5.2
22	B2	Spongy	Little fragrance	Little fragrance	Little sticky	4.3
23	B3	Spongy	Little fragrance	Fragrant	Little sticky	5.2
24	B4	Spongy	Non-fragrant	Non-fragrant	Little sticky	4.4
25	B5	Little solid	Non-fragrant	Non-fragrant	Little sticky	3.5
26	B6	Solid	Little fragrance	Non-fragrant	Little sticky	3.8
27	B7	Little solid	Little fragrance	Non-fragrant	Little sticky	4.4
28	B8	Little solid	Non-fragrant	Non-fragrant	Little sticky	4.2
29	B9	Solid	Little fragrance	Little fragrance	Sticky	3.6
30	B10	Little solid	Fragrant	Fragrant	Little sticky	3.7
31	B12	Solid	Little fragrance	Non-fragrant	Little sticky	4.9
32	B13	Little solid	Non-fragrant	Non-fragrant	Little sticky	3.8
33	B14	Little solid	Little fragrance	Non-fragrant	Sticky	4.2
34	B15	Solid	Little fragrance	Little fragrance	Little sticky	3.9

35	B16	Little solid	Non-fragrant	Non-fragrant	Little sticky	4.5
36	B17	Little solid	Non-fragrant	Non-fragrant	Little sticky	4.2
37	B18	Spongy	Little fragrance	Non-fragrant	Little sticky	5.4
38	B19	Solid	Non-fragrant	Non-fragrant	Little sticky	4.4
39	B21	Spongy	Non-fragrant	Non-fragrant	Sticky	4.2
40	B22	Little solid	Little fragrance	Fragrant	Little sticky	4.3
41	B23	Spongy	Non-fragrant	Non-fragrant	Little sticky	3.9
42	B24	Solid	Non-fragrant	Non-fragrant	Sticky	5.6
43	B25	Little solid	Non-fragrant	Non-fragrant	Little sticky	4.1
44	B26	Little solid	Non-fragrant	Non-fragrant	Little sticky	4.1
45	B27	Solid	Little fragrance	Non-fragrant	Little sticky	3.4
46	B28	Little solid	Non-fragrant	Non-fragrant	Sticky	3.9
47	B29	Solid	Non-fragrant	Non-fragrant	Sticky	5.1
48	B30	Solid	Fragrant	Fragrant	Little sticky	3.8
49	Control check	Little solid	Fragrant	Little fragrance	Little sticky	4.1

3.5 Diseases and pests.

The results were recorded in Table 6.

Reddish-brown lesions (Rhizoctonia solani): Almost accessions were infected this disease. Accession A2 was highly susceptible to this disease (66.7%) and A25 showed resistance to this disease (9.1%).

The black cutworm (Agrotis ipsilon): The black cutworm attacked the Sponge gourd germplasm during experiment. It caused damage to most accessions at the seedling period.

Leafminer (Phyllocnistis citrella) and cucumber moth (Diaphania indica): Some accessions such as B6, B8, B11, B12, B21 and B22 were totally damaged by *leafminer* and cucumber moth. Some remaining accessions had harmful ratio changed from 33.3% to 83.3%.

Table 6. Ratio of plants damaged by diseases and pests

NO.	Accession name	PDP by Reddish-brown lesions(%)	Damaged plants by *Agrotis ipsilon*(%)	Damaged plants by cucumber moth (%)	Damaged plantsbyleafminer (%)	NO.	Accession name	PDP by Reddish-brown lesions(%)	Damaged plants by *Agrotis ipsilon*(%)	Damaged plants by cucumber moth (%)	Damaged plantsbyleafminer (%)
1	A1	33.3	33.3	50	33.3	**26**	B6	30	16.7	100	100
2	A2	66.7	50	83.3	50	**27**	B7	0	16.7	83.3	83.3
3	A3	16.7	33.3	50	50	**28**	B8	20	33.3	100	100
4	A4	0	16.7	100	66.7	**29**	B9	0	33.3	83.3	66.7
5	A5	14.3	16.7	100	100	**30**	B10	16.7	16.7	50	50
6	A6	16.7	16.7	66.7	33.3	**31**	B12	10	0	100	100
7	A7	16.7	33.3	66.7	66.7	**32**	B13	0	0	66.7	66.7
8	A10	44.4	33.3	83.3	83.3	**33**	B14	11.1	16.7	66.7	50
9	A11	0	0	66.7	50	**34**	B15	0	0	100	83.3
10	A12	0	50	83.3	83.3	**35**	B16	22.2	16.7	100	50
11	A13	16.7	0	100	83.3	**36**	B17	0	16.7	50	33.3
12	A15	0	0	83.3	66.7	**37**	B18	0	0	83.3	66.7
13	A16	12.5	16.7	50	50	**38**	B19	12.5	16.7	33.3	16.7
14	A17	33.3	16.7	50	50	**39**	B21	11.1	16.7	100	100
15	A18	0	33.3	66.7	50	**40**	B22	0	16.7	100	100
16	A19	57.1	16.7	100	83.3	**41**	B23	28.6	16.7	83.3	66.7

17	A20	33.3	33.3	83.3	66.7	**42**	B24	0	0	83.3	83.3
18	A25	9.1	0	66.7	50	**43**	B25	0	16.7	66.7	50
19	A29	0	16.7	83.3	50	**44**	B26	16.7	16.7	50	50
20	A30	11.1	33.3	100	100	**45**	B27	14.3	16.7	66.7	16.7
21	B1	10	50	50	50	**46**	B28	11.1	16.7	100	50
22	B2	0	0	33.3	33.3	**47**	B29	11.1	0	100	66.7
23	B3	0	0	66.7	33.3	**48**	B30	0	0	50	50
24	B4	12.5	33.3	83.3	66.7	**49**	Con-trol check	16.7	33.3	50	66.7
25	B5	18.2	16.7	83.3	83.3						

PDP: percentage of damaged plants

4 Conclusions and suggestions

Conclusions

1. All 49 accessions expressed difference in agricultural and biological properties. Some accessions such as A16, A17, B1, B2, B3, B4, B10, B16, B18, B19, B27, B29 and B30 had high ability of growth and development under Gia Lam, Ha Noi condition.

2. Some promising varieties had high yeild such as B16, B27 and B30.

3. Fruit quality:

- 21 accessions had solid flesh: A3, A4, A5, A6, A7, A10, A15, A17, A18, A19, A29, A30, B6, B9, B12, B15, B19, B24, B27, B29 and B30.

- 4 accessions had aroma after being cooked: A16, B10, B22 and B30

- 15 accessions had sticky character: A2, A4, A6, A7, A13, A15, A16, A20, A29, B9, B14, B21, B24, B28 and B29.

- Some accessions such as A12, A13, B1, B3, B24 and B29 had Brix ≥ 5.

4. Diseases and pests did not influence quality of fruit and yield of 49 accessions.

5. Some accessions had valuable properties, high yield and good qualities will be severed as promising materials from breeding programme.

Suggestions

1. Continue study on sponge gourd germplasm in different seasons and ecological areas to define complete potential of varieties.
2. Use varieties that have high yield and good qualities (aromatic, sticky, and Brix) in sponge gourdbreeding programme.

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