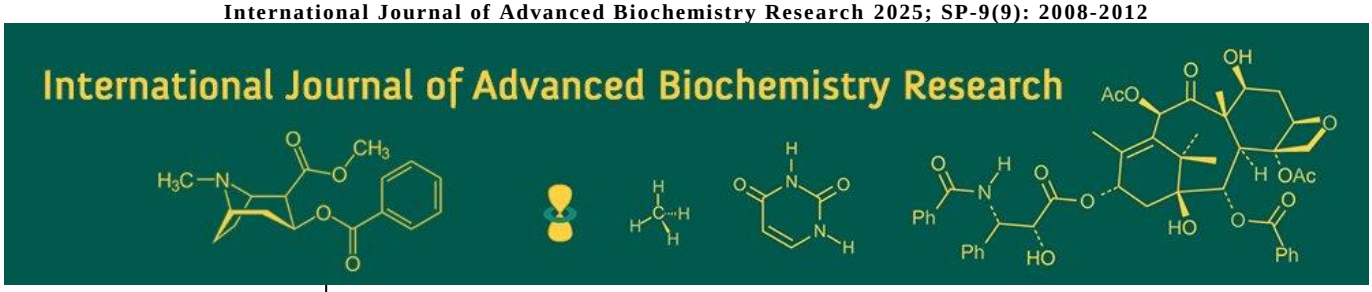

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Growth and instability analysis of cucurbit vegetables in Tamil Nadu with special reference to Dharmapuri district

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Abstract
Vegetable cultivation plays a vital role in ensuring food and nutritional security in India, with Tamil Nadu contributing significantly to the national vegetable production. Among the diverse vegetables grown, cucurbit crops are economically important and widely cultivated due to their nutritional value and livelihood support for small and marginal farmers. This study examined the growth and instability in area, production and productivity of major cucurbit vegetables, including ash gourd, bottle gourd, bitter gourd, ridge gourd, snake gourd and other minor cucurbits, in Tamil Nadu and Dharmapuri district over a ten-year period. Secondary data from government sources were analysed using Compound Annual Growth Rate (CAGR) to assess growth trends and Cuddy Della Valle Index (CDVI) to measure instability. The results indicated an overall positive growth in both area and production of cucurbits across the state, with productivity showing varied patterns among different crops. Dharmapuri district demonstrated comparatively higher growth rates than the state average, highlighting its importance as a leading hub for cucurbit cultivation. Instability analysis revealed that fluctuations in area and production were more pronounced in Dharmapuri, particularly for certain gourd varieties, while productivity remained relatively stable for most crops.

Keywords: Growth rate, instability index, cucurbit vegetables

Introduction
Vegetable cultivation plays a crucial role in ensuring global food and nutritional security, with India ranking as the second largest vegetable producer in the world, generating about 162 million tonnes annually from 9.2 million hectares of land. Tamil Nadu makes a significant contribution to this achievement, accounting for nearly 3 per cent of the country's vegetable cultivation area and 5 per cent of national production (A. Rani, 2020) [9]. Among the wide range of vegetables grown, cucurbit crops form one of the most diverse and economically valuable groups. Belonging to the family Cucurbitaceae, this group comprises approximately 800 species across 130 genera (Y. Weng, 2012) [10] and includes several high-value gourds and melons that are cultivated for their nutritional, culinary, and medicinal properties. Cucurbits are dioecious in nature and are well suited to tropical and subtropical climates, making them ideal for sustainable agricultural systems in India. When combined with bio-fertilizers and balanced chemical fertilization, these crops show considerable promise for enhancing soil health, reducing production costs and ensuring livelihood security for marginal and smallholder farmers (D. Nayak *et al*., 2024) [6]. Within the cucurbit group, gourd varieties such as bitter gourd, bottle gourd, snake gourd, sponge gourd and ridge gourd occupy a special place in the diets of southern and southeastern Asia. These vegetables are rich in vitamins A and C, iron, calcium, and dietary fibre, providing not only income but also essential nutrients for rural households (N. Dhillon *et al*., 2016) [7].
In Tamil Nadu, the cultivation of gourd crops has shown a steady and consistent increase in both area and production over the past decade, driven by rising market demand, better agronomic practices and government support. Among all the districts, Dharmapuri has emerged as the leading centre for cucurbit cultivation, contributing more than 30 per cent of the state's total area and production. According to the Department of Horticulture and Plantation Crops (2023-24), Dharmapuri has maintained the first rank in Tamil Nadu for cucurbit vegetable growth for the past five years, highlighting its pivotal role in

strengthening the state's vegetable economy and ensuring a reliable supply of gourds to regional markets. Considering the importance of the cucurbit vegetables, the present study was undertaken with the following specific objectives, to examine the growth and instability in area, production and productivity of cucurbit vegetables in Tamil Nadu and the study area.

Materials and Methods

The present study on the growth of area, production, and productivity of cucurbit vegetables was purposively undertaken in Dharmapuri district as well as in Tamil Nadu to understand the recent trends in their cultivation. The major cucurbit crops were identified based on their acreage and production levels, as they play a key role within the Cucurbitaceae family and occupy a significant share of the total cucurbit area in both the district and the state. The crops selected for detailed analysis include ash gourd, bottle gourd, bitter gourd, ridge gourd, snake gourd, and a group categorized as "others," which comprises cucumber, pumpkin, ivy gourd, and chow chow. The study utilized secondary data on area and production of these crops for the ten-year period from 2014-2015 to 2023-2024 were used to analyze the trends. Data were compiled from various published sources, primarily the Area Coverage reports of the Department of Horticulture and Plantation Crops, Chennai, Tamil Nadu. Additional season-wise crop details were obtained from the Season and Crop Reports published by the Directorate of Economics and Statistics (DES). The method used for estimating the growth rate and instability index has been described below:

Compound Annual Growth Rate (CAGR)

CAGR reveals the tendency of a variable to increase, remain constant or decrease over a long period of time. It was estimated by exponentially fitting the time-series data on area, production and productivity against time using the method suggested by Gujarati (1988) [8]. The equation is as follows (Anjali and Anil, 2023):

$$Y_t = ae^{bt} \quad (1)$$

Where,
Y_t is area (or) production (or) productivity in year t
a is intercept
b is regression coefficient
t is year taking values 1,2,3,.,n.
Transforming equation (1) in log linear form:

$$\log Y_t = \log a + t \log b \quad (2)$$

Expression of CAGR in percentage

$$CAGR = [(\text{antilog } b) - 1] * 100 \quad (3)$$

The significance of the regression coefficient was tested using t-test.

Cuddy-Della Valle Index (CDVI)

To measure the instability in the area, production and productivity of cucurbit vegetables during the period 2014-2015 to 2023-24, the Cuddy-Della Vella Index was employed. This method calculates the degree of variation around the trend using the formula suggested by Cuddy and Della Valle (1978) [4]. Specifically, the coefficient of variation (CV) is multiplied by the square root of the difference between the unity and the coefficient of multiple determination (R^2), in cases where R^2 was significant to obtain the Instability Index. The level of instability was thus derived from the Cuddy-Della Valle index,

$$CDVI = CV \times \sqrt{1 - \text{Adjusted } R^2}$$

Where,
CV is the coefficient of variation (CV) (in per cent) and
r^2 = Coefficient of determination from a time trend regression adjusted by the number of degrees of freedom.
Based on the reference (D. M. Madhu *et al*., 2024) [5], the ranges are fixed and the categorization of instability range as follows:

1. Low instability: 0 > CDVI < 15;
2. Medium instability: 15 > CDVI < 30;
3. High instability: CDVI >30.

Results and Discussion

The main focus of this paper was to examine the year-to-year growth and fluctuations in cucurbit vegetables. Accordingly, the growth trend and instability in the area, production and productivity of major cucurbit vegetables in Dharmapuri were studied at the district and state-levels of the period 2014-2015 to 2023-24.

Compound Annual Growth Rate (CAGR) of Cucurbit Vegetables

The CAGR analysis of cucurbit vegetables revealed a clear trend of expansion in both area and production in Tamil Nadu as well as in Dharmapuri district, though productivity exhibited mixed patterns.

At the state level, ash gourd and bottle gourd exhibited the highest growth in area (16.45 per cent and 15.42 per cent) and production (18.43 per cent and 16.71 per cent, respectively), but the gains in productivity were marginal. Bitter gourd showed moderate growth in area (8.64 per cent) and production (10.57 percent) with a notable improvement in productivity (1.77 per cent). Snake gourd maintained moderate growth in area (11.27 per cent) and production (11.60 per cent) but showed little change in productivity (0.29 per cent). Ridge gourd and other cucurbits displayed a different pattern, with expansion in area (14.52 per cent and 12.45 per cent) and production (12.29 per cent and 9.52 per cent) but a sharp decline in productivity (-1.94 per cent and -2.61 per cent) are presented in Table 1. Fig-1 represents the trend of area and production of major cucurbit vegetables grown in Tamil Nadu, showing a positive trend over the years.

From Table 2, in Dharmapuri district, the growth rates were more pronounced compared to the state averages, especially for ash gourd and bottle gourd, which showed unexpected growth in area (43.83 per cent and 35.51 per cent) and production (45.04 per cent and 37.76 per cent) with only marginal improvement in productivity. Bitter gourd recorded a moderate increase in area (9.46 per cent) and production (12.24 per cent), along with a strong and significant gain in productivity (2.54 per cent). Snake gourd

exhibited healthy growth in area (15.75 per cent) and production (17.10 per cent) with no significant change in productivity (1.16 per cent). Ridge gourd and other cucurbits showed positive growth in area (15.24 per cent and 30.97 per cent) and production (9.65 per cent and 26.19 per cent) but their productivity declined (-4.85 per cent and -3.65 per cent). Fig-2 represents the trend of area and production of major cucurbit vegetables grown in Dharmapuri, showing a positive trend over the decade.

Table 1: Compound Annual Growth Rate of Cucurbit Vegetables in Tamil Nadu.

Particulars	Area		Production		Productivity	
Crops	CAGR	P - Value	CAGR	P - Value	CAGR	P - Value
Ash Gourd	16.45***	0.000	18.43***	0.000	1.70**	0.052
Bottle Gourd	15.42***	0.000	16.71***	0.000	1.11	0.151
Bitter Gourd	8.64***	0.005	10.57***	0.003	1.77***	0.000
Ridge Gourd	14.52***	0.000	12.29***	0.000	-1.94**	0.015
Snake Gourd	11.27***	0.001	11.60***	0.001	0.29	0.711
others	12.45***	0.000	9.52***	0.001	-2.61***	0.000

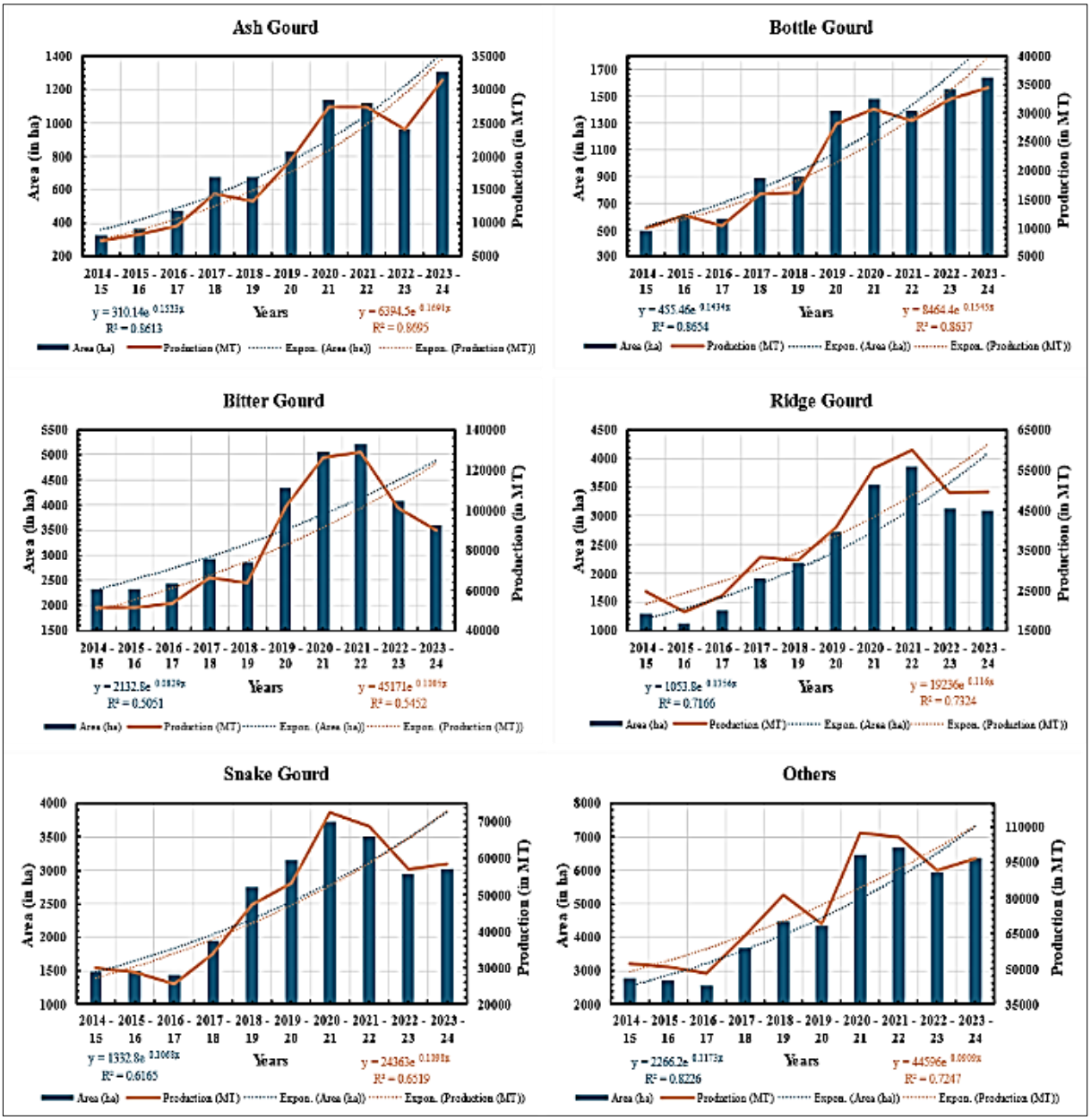

Fig 1: Growth and Trends in Area and Production of Cucurbit Vegetables in Tamil Nadu.

Table 2: Compound Annual Growth Rate of Cucurbit Vegetables in Dharmapuri.

Particulars	Area		Production		Productivity	
Crops	CAGR	P - Value	CAGR	P - Value	CAGR	P - Value
Ash Gourd	43.83***	0.000	45.04***	0.000	0.83	0.148
Bottle Gourd	35.51***	0.001	37.76***	0.001	1.66**	0.025
Bitter Gourd	9.46**	0.019	12.24***	0.009	2.54***	0.002
Ridge Gourd	15.24***	0.001	9.65***	0.006	-4.85***	0.009
Snake Gourd	15.75***	0.001	17.10***	0.002	1.16	0.291
others	30.97***	0.001	26.19***	0.001	-3.65	0.165

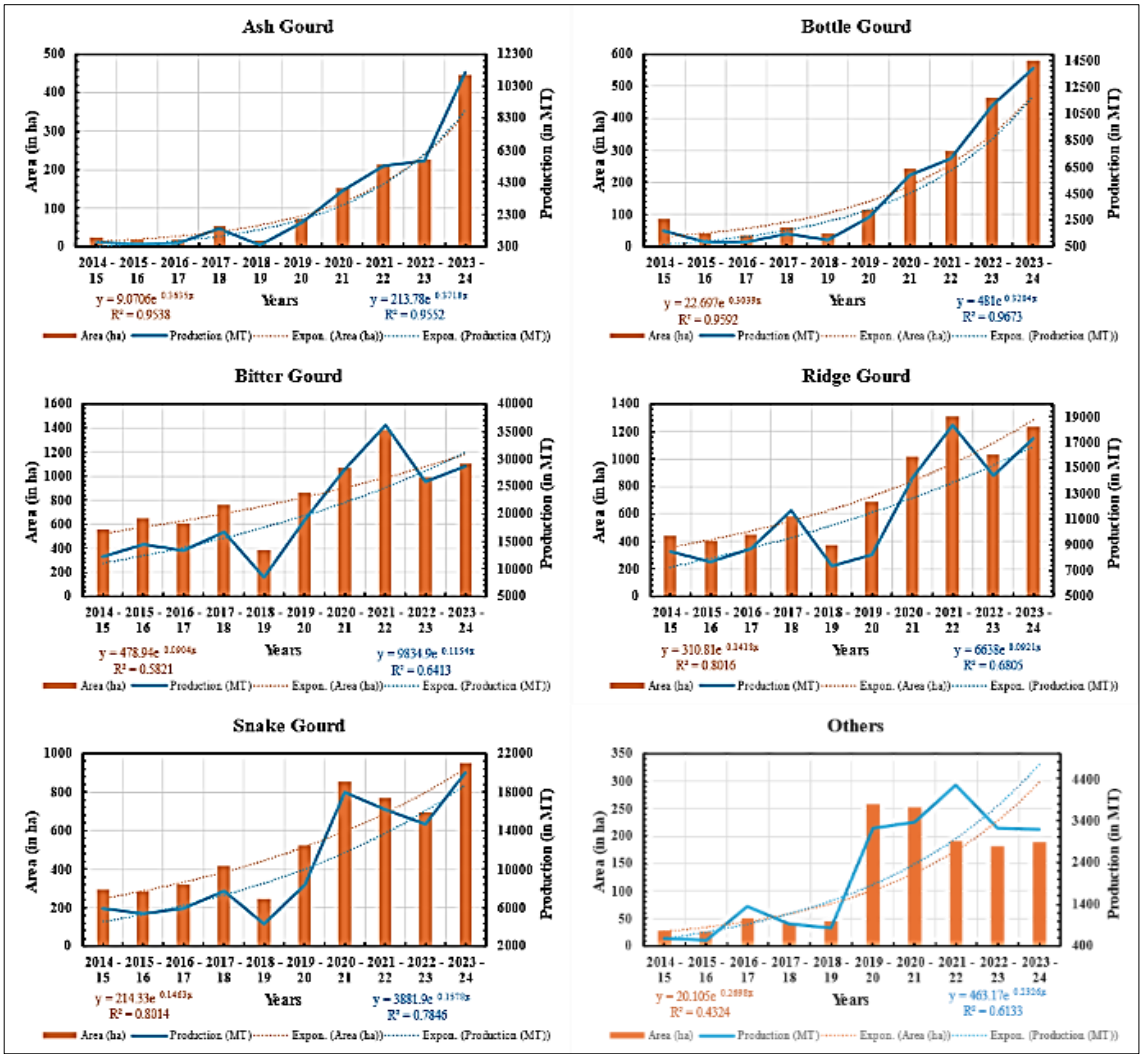

Fig 2: Growth and Trends in Area and Production of Cucurbit Vegetables in Dharmapuri.

Cuddy Della Valle Index (CDVI) on Cucurbit Vegetables

The estimated CDVI of cucurbit vegetables revealed that instability in cucurbit cultivation is more pronounced in Dharmapuri district compared to Tamil Nadu.

From Table 3, at the state level, ash gourd, bottle gourd and others showed low instability in area and mostly medium variations in production. Bitter gourd, ridge gourd and snake gourd exhibited moderate instability in both area and production but low instability in productivity across all crops.

Table 3: Instability Index on Cucurbit Vegetables in Tamil Nadu.

Particulars	Area		Production		Productivity	
Crops	CDVI	Range	CDVI	Range	CDVI	Range
Ash Gourd	13.53	Low	15.49	Medium	6.43	Low
Bottle Gourd	11.92	Low	14.70	Low	6.13	Low
Bitter Gourd	22.06	Medium	23.97	Medium	2.32	Low
Ridge Gourd	19.23	Medium	17.90	Medium	5.84	Low
Snake Gourd	19.81	Medium	20.35	Medium	6.83	Low
others	14.24	Low	15.52	Medium	3.03	Low

Table 4: Instability Index on Cucurbit Vegetables in Dharmapuri

Particulars	Area		Production		Productivity	
Crops	CDVI	Range	CDVI	Range	CDVI	Range
Ash Gourd	14.35	Low	16.78	Medium	4.21	Low
Bottle Gourd	50.54	High	49.64	High	5.17	Low
Bitter Gourd	24.64	Medium	27.96	Medium	5.00	Low
Ridge Gourd	23.75	Medium	22.38	Medium	12.47	Low
Snake Gourd	24.29	Medium	29.70	Medium	4.32	Low
others	50.93	High	35.78	High	20.53	Medium

Table 4 shows that, in Dharmapuri district bitter gourd, ridge gourd and snake gourd recorded medium instability in area and production similar to Tamil Nadu, but with slightly higher magnitudes. Ash gourd remained relatively stable with low to medium instability in both area and production. In contrast, bottle gourd and others displayed very high instability in area and production. However, productivity remained low in instability for all crops, as similar to the state level, except for the others category which showed medium instability.

Conclusion

The analysis of cucurbit crops in Tamil Nadu revealed an overall positive growth trend, with bitter gourd, ridge gourd

and snake gourd showing the highest expansion. In Dharmapuri district, these three crops dominated cultivation, while cucumber, pumpkin and other minor cucurbits contributed only marginally due to perishability and lower price realization. Instability analysis using the Cuddy–Della Valle Index indicated that most crops at the state level had low to medium variability in area and production, with productivity remaining relatively stable. In Dharmapuri, certain crops particularly bottle gourd and minor cucurbits, exhibited higher instability, whereas bitter gourd, ridge gourd and snake gourd maintained moderate growth with medium instability, reflecting both opportunities and manageable production risks. The predominance of these major gourds can be attributed to their agro-climatic suitability, higher productivity, continuous harvesting advantage and steady market demand. Focused technological interventions, improved management practices and market support are essential to sustain their cultivation and enhance farmer income, ensuring balanced and stable growth of cucurbit production in the region.

References

1. Tiwari A, Kumar A. Growth and instability analysis of production of major vegetables in Uttarakhand. Int J Agric Sci. 2023;15(2):12206-12208.
2. Anonymous. Department of Horticulture and Plantation Crops, Government of Tamil Nadu; 2023-24.
3. Anonymous. Area coverage – season and crop report. Department of Economics and Statistics, Tamil Nadu.
4. Cuddy JDA, Della VPA. Measuring of instability of time series data. Oxf Bull Econ Stat. 1978;40(1):79-81.
5. Madhu DM, Basavaraj G, Manisha VVD, Hanumanthappa R, Moolimane CB. An overview of millets production in India: growth and instability. J Exp Agric Int. 2024;46(10):213-25. doi:10.9734/jeai/2024/v46i102940.
6. Nayak DA, Mohanty S, Jena S. A review on effect of bio-fertilizers and chemical fertilizers on growth, yield and quality of dioecious cucurbits. J Sci Res Rep. 2024;30(5):556-63. doi:10.9734/jsrr/2024/v30i51971.
7. Dhillon NPS, *et al*. Gourds: bitter, bottle, snake, sponge and ridge. In: Grumet R, Katzir N, Garcia-Mas J, editors. Genetics and genomics of Cucurbitaceae. Plant genetics and genomics: crops and models. Vol 20. Cham: Springer; 2016. doi:10.1007/7397_2016_24.
8. Gujarati DN. Basic econometrics. 2nd ed. New York: McGraw-Hill International Editions, Economic Series; 1988. p. 154-6.
9. Rani JA. Factors responsible for the yield gap in vegetable cultivation and measures to increase the productivity in Tamil Nadu, India. Int J Curr Microbiol Appl Sci. 2020;9(9):1017-25. doi:10.20546/ijcmas.2020.909.126.
10. Weng Y. Major cucurbit crops. Agric Food Sci. 2012. doi:10.1201/b11436-2.