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Assessment of genetic variability and morphological screening of guava (*Psidium guajava* L.) hybrids

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Abstract

The study was carried out to estimate morphological parameters of guava hybrids. In the experiment undertaken, fourteen guava (*Psidium guajava* L.) hybrids were evaluated for selected thirty- eight morphological characters using CRD in three repetitions. Out of which eight characters are presented here. Among the different hybrid of guava erect type attitude of branches (branching habit) was noted for hybrids Local Red x Allahabad Safeda, Allahabad Safeda x Dholka, Local Red x Mishri, Local Red x Matchless and Allahabad Safeda x Exotica whereas dark red colour of stem was observed with Allahabad Safeda x Dholka. While Medium density of pubescence was observed for Local Red x Allahabad Safeda, Allahabad Safeda x Chittidar, Local Red x Chittidar, Allahabad Safeda x Dholka, Local Red x Matchless and Anthocyanin colouration present was noted for Allahabad Safeda x Apple Colour, Local Red x Dholka, Allahabad Safeda x Dholka, Local Red x Mishri, Allahabad Safeda x Matchless, Allahabad Safeda x Mishri and Allahabad Safeda x Tehsildar. The highest length of leaf blade (15.46 cm) and width of leaf blade (6.57 cm) was recorded for Allahabad Safeda x Local Red while highest length/width ratio of blade was observed for Allahabad Safeda x Chittidar (2.69 cm).

The trullate shape of leaf was recorded for Allahabad Safeda x Local Red, Local Red x Dholka, Allahabad Safeda x Dholka, Allahabad Safeda x Matchless and Allahabad Safeda x Mishri. The genotypic variance contributing to phenotypic variance was moderate for length of leaf blade and length/width ratio of blade whereas high for width of leaf blade. Low estimate of GCV and PCV indicated the existence of low variability for length of leaf blade and length/width ratio of leaf blade. However lower to moderate estimate of GCV and PCV indicated the existence of moderate amount of variability for width of leaf blade.

Keywords: Genetic variability, phenotypic variability, genotypic coefficient of variation, phenotypic coefficient of variation, morphological screening, hybrids

1. Introduction

Guava (*Psidium guajava* L.) belongs to Myrtaceae family is native of America; however, was introduced to another region of the world where it is cultivated nowadays. It is an important tropical commercial fruit crop of India. It is also known as "Apple of the tropics", *amarood*, *jamphal* or *jamruk* in Hindi in India. Guava is the fourth most important fruit crop in India after Mango, Banana and Citrus (Ray, 2002) [16]. Guava is the hardiest among tropical fruit trees and excels most of the other fruit crops in productivity and adaptability. It can resist water logged condition to a greater extent than other fruit crop. It can also withstand temperature up to 45 °C. In India it occupies a cultivated area of 251.02 thousand hectares with an annual production of 4083.26 thousand tones with average productivity of 16.3 tones ha⁻¹ (Anon., 2015a) [2]. The fruit is extensively grown in Uttar Pradesh, Bihar, Madhya Pradesh, Gujarat, West Bengal, Orissa and Tripura. Genus *Psidium* contains about 150 species (Hayes, 1974) [9]. All cultivated varieties of guava either diploid 2n=2x =22 or triploid 2n=3x =33 (Atchinson, 1947) [3]. However, Uttar Pradesh is an important guava producing state and Allahabad has the reputation of growing the best guava in the world. In guava, most of the commercial varieties are reported to be diploids, except the seedless types which are triploids. A natural triploid was reported by Kumar and Ranade (1952) [11], but most of them are shy bearers (Menzel, 1985) [13]. Guavas are symmetrically dome-shaped with broad, spreading, low branching canopy, shallow-rooted shrubs reaching a height of up to 33 feet (Morton, 1987) [14]. They can be easily recognized by the smooth, mottled green or copper-colored bark that peels off in thin flakes, showing the attractive "bony" aspects of its trunk (Yadava, 1996) [21]. It is a popular fruit of India due to its delightful taste, flavour and easy availability.

The lycopene content in fruit has been found to give rise to the pink flesh, which contains 3 mg of carotene/100g of fruit. The young fruits are rich in tannin. The tartness of guava has been ascribed to the pH of around 3-4, breeding programme mainly depends upon variability and correct selection. Moreover, guava scores over other fruits in ascorbic acid, pectin and other mineral contents. Assessment of diversity has traditionally been achieved through chemical composition, and cytological studies however; they have several limitations especially in perennial crops. Despite the fact that biochemical characters are often limited in number, they have a complex inheritance pattern and are vulnerable to environmental conditions; it is easy and cheap to carry them out and can be carried out systematically.

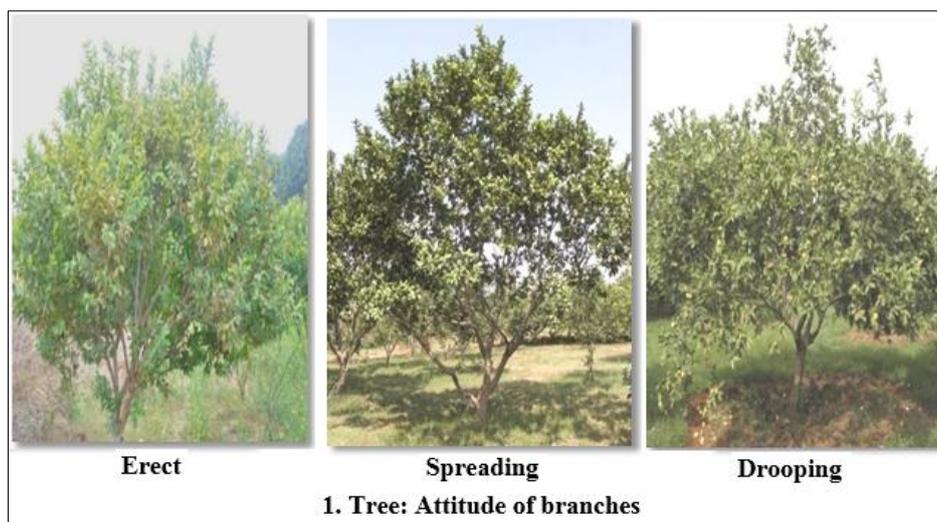
2. Materials and Methods

The present findings “Assessment of genetic variability and morphological screening of guava (*Psidium guajava* L.) Hybrids” was carried out on 14 different hybrids of guava, planted on 09-08-2012 and maintained at Horticultural Research-cum-Demonstration Farm, Department of Horticulture, B. A. College of Agriculture, An and during the Rabi-2016. The climate of Anand region represents a typical tropical climate and soil of the experimental field was sandy loam, locally known as which is largely due to the presence of maleic and citric acids. Over 15 compounds have been identified in the volatile flavor constituents of guavas (Chan *et al.* 1971) [5]. It is a popular fruit of India due to its delightful taste, flavour and easy availability. Guava is used for preparation of jams, jellies, juices, cakes, pies, ice-cream,

milk shakes, sauces, butter, cheese, marmalade, chutney, relish, pickle, puree, beverages, ethanol, wine, animal feed, baby food, soft- drinks, as source of pectin, etc. Fisher (1918) [8] suggested that continuous variation exhibited by quantitative traits with which plant breeders” deal includes heritable and non-heritable characters. Selection is effective for variation which is heritable in nature. The heritable component is the consequence of genotypes, while the non-heritable part is mainly due to unknown environmental factors. The proper choice of parents responsible for successful, ‘*Goradu*’. It is alluvial by its origin and very deep, well drained and with fairly good moisture holding capacity. The experiment was laid out in Completely Randomized Design with fourteen hybrids. Hybrids act as treatment and each plant from treatment like repetition. Five leaves of similar size and same age were collected randomly from each repetition from all fourteen hybrids as sample for assessment of various morphological parameters. Tree habit was observed visually for spreading, drooping or erect type with dense, medium dense or very dense canopy of tree and young shoot colour of stem was observed visually for outer appearance of shoot as green, green with red streak or dark red. Pubescence present on lower side of leaves observed visually for outer appearance of leaves as to be absent, sparse, medium, dense or very dense and anthocyanin colouration present in leaves observed visually with the outer appearance of leaves as present or absent. While length and width of leaf blade are recorded by using scale and expressed in cm as short (<10.0 cm) or long (>10.0 cm) and narrow (<4.0 cm) or broad (>4.0 cm) respectively

Table 2.1: Explanation of table of characteristics

S. No.	Characteristics	States
1.	Tree: attitude of branches	Erect Spreading Drooping
2.	Young shoot: colour of stem	Green Green with red streaks Dark red
3.	Young leaf: pubescence on lower side	Absent Present
4.	Young leaf: anthocyanin coloration	Absent Present
5.	Fully developed leaf: length of blade (cm)	Short (< 10.0 cm) Long (> 10.0 cm)
6.	Fully developed leaf: width of blade (cm)	Narrow (< 4.0 cm) Broad (>4.0 cm)
7.	Fully developed leaf: length/width ratio of blade (cm)	Narrow (<2.50cm) Broad (>2.50 cm)
8.	Fully developed leaf: shape	Round Trullate Oblong



Whereas the ratio of length and width of blade was calculated by average length of leaf blade was divided by average width of leaf blade for each randomly selected five leaves for every hybrid. Leaf shape was observed visually based on leaf

margin and recorded as round, trullate or oblong. Phenotypic and genotypic coefficient of variation (GCV & PCV) were computed according to Burton (1952) [4]. As classified and suggested by Sivasubramanian and Menon (1973) [22], GCV

and PCV were categorized. The estimates of variance (genotypic and phenotypic) and coefficient of variation (genotypic and phenotypic) for different morphological parameters of guava hybrids are presented in Table. 3.2

Result and Discussion

All Fourteen hybrids were evaluated for various qualitative traits related to eight morphological characters

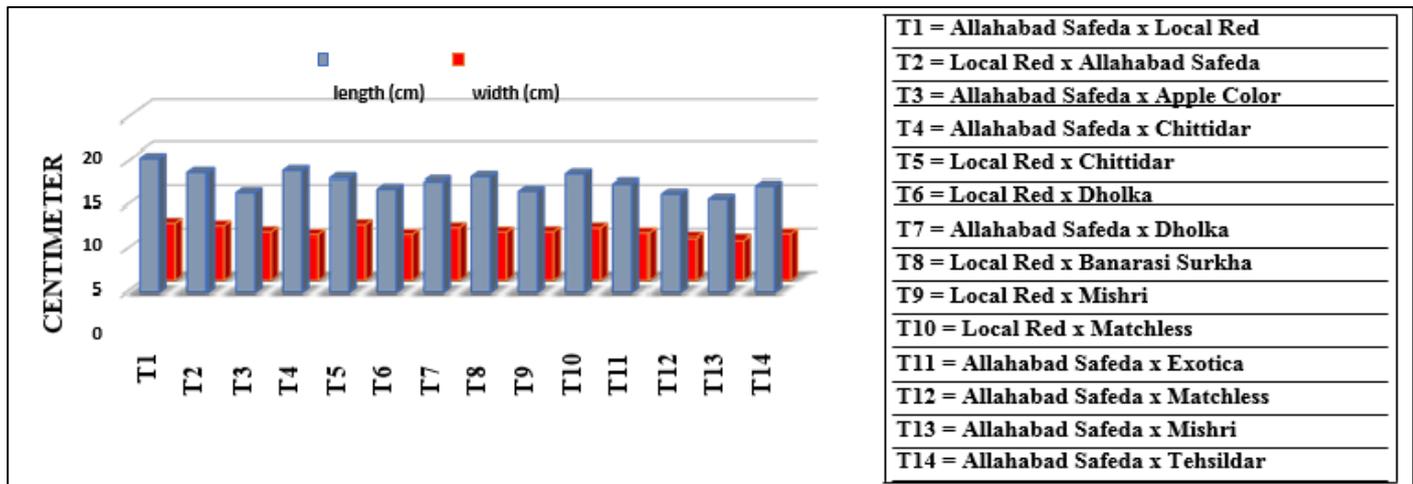


Fig 1: Variation in length of leaf blade and width of leaf blade for different guava hybrids.

Tree: Attitude of branches

Erect type attitude of branches was recorded for Local Red x Allahabad Safeda, Allahabad Safeda x Dholka, Local Red x Mishri, Local Red x Matchless and Allahabad Safeda x Exotica. While Spreading type attitude of branches recorded for Allahabad Safeda x Local Red, Allahabad Safeda x Chittidar, Local Red x Chittidar, Local Red x Dholka, Local Red x Banarasi Surkha, Allahabad Safeda x Tehsildar. Whereas drooping type attitude of branches was recorded for rest of guava hybrids (Table 3.1) which was close conformity with the reported by some earlier worker viz., Patel (2006) [15] and Sharma *et al.* (2010) [20] and Kumar *et al.* (2012) [12].

Young shoot: Colour of the stem

Green with red streak colour of stem was recorded for Local Red x Allahabad Safeda, Allahabad Safeda x Apple Colour, Allahabad Safeda x Chittidar, Local Red x Dholka, Local Red

x Mishri, Local Red x Matchless, Allahabad Safeda x Matchless, Allahabad Safeda x Mishri, and Allahabad Safeda x Tehsildar. While dark red observed with Allahabad Safeda x Dholka. Whereas green colour was recorded for rest of guava hybrids (Table 3.1) which was close conformity with the reported by earlier research finder Singh (2013) [18].

Young leaf: Pubescence on lower side of leaf

Medium density of pubescence was recorded for Local Red x Allahabad Safeda, Allahabad Safeda x Chittidar, Local Red x Chittidar, Allahabad Safeda x Dholka, Local Red x Matchless. Whereas sparse density of pubescence was recorded for rest of guava hybrids (Table 3.1). These observations are close conformity with the reported by Ehleringer *et al.* (1978) [7], Kumar *et al.* (2012) [12] and Santos *et al.* (2012) [7].

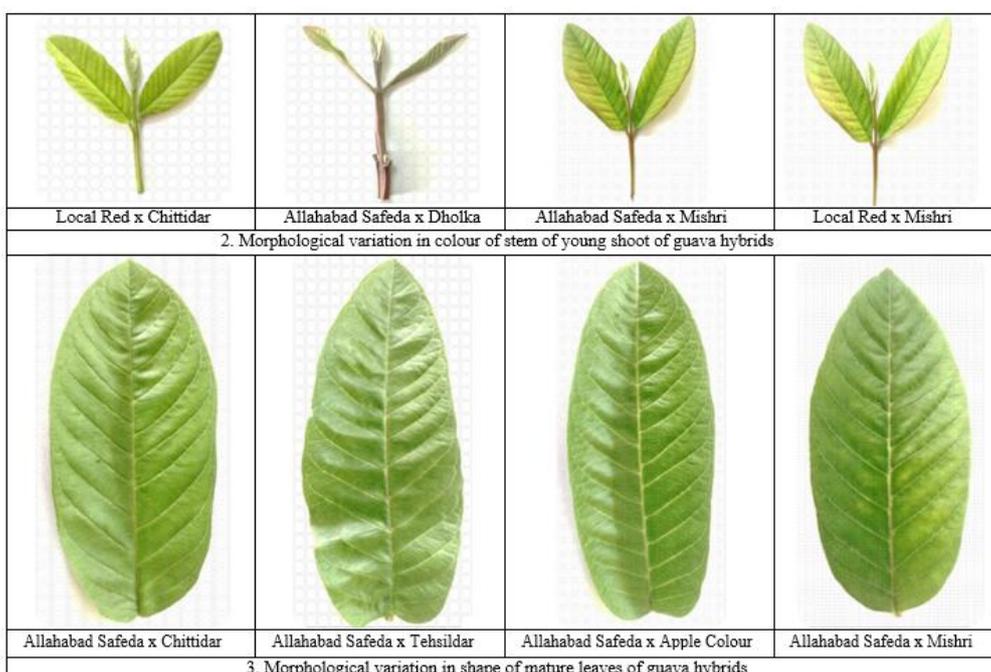


Table 3.1: Summary of various qualitative characters of guava hybrids

S. No.	Hybrids	Attitude of Branches	Young shoot	Young leaf		Mature leaf
			Colour of stem	Pubescence on lower side	Anthocyanin Coloration	Shape
1.	Allahabad Safeda x Local Red	Spreading	Green	Sparse	Absent	Trullate
2.	Local Red x Allahabad Safeda	Erect	Greenish with red streak	Medium	Absent	Oblong
3.	Allahabad Safeda x Apple Colour	Drooping	Greenish with red streak	Sparse	Present	Oblong
4.	Allahabad Safeda x Chittidar	Spreading	Greenish with red streak	Medium	Absent	Oblong
5.	Local Red x Chittidar	Spreading	Green	Medium	Absent	Oblong
6.	Local Red x Dholka	Spreading	Greenish with red streak	Sparse	Present	Trullate
7.	Allahabad Safeda x Dholka	Erect	Dark red	Medium	Present	Trullate
8.	Local Red x Banarasi Surkha	Spreading	Green	Sparse	Absent	Oblong
9.	Local Red x Mishri	Erect	Greenish with red streak	Sparse	Present	Oblong
10.	Local Red x Matchless	Erect	Greenish with red streak	Medium	Absent	Oblong
11.	Allahabad Safeda x Exotica	Erect	Green	Sparse	Absent	Oblong
12.	Allahabad Safeda x Matchless	Drooping	Greenish with red streak	Sparse	Present	Trullate
13.	Allahabad Safeda x Mishri	Drooping	Greenish with red streak	Sparse	Present	Trullate
14.	Allahabad Safeda x Tehsildar	Spreading	Greenish with red streak	Sparse	Present	Oblong

Table 3.2: Estimates of genotypic (σ_g^2) and phenotypic (σ_p^2) variance and coefficient of variation (genotypic and phenotypic) for different morphological parameters of guava hybrids

S. No.	Characters/Parameters	Mean	Min.	Max.	$\sigma_2 g$	$\sigma_2 p$	Genotypic	Phenotypic
1.	Length of leaf blade (cm)	12.73	10.73	15.46	1.35	2.18	9.11	11.59
2.	Width of leaf blade (cm)	5.61	4.63	6.57	0.24	0.49	8.76	12.45
3.	Leaf length/width ratio	2.28	2.06	2.69	0.02	0.05	5.70	9.58

Young leaf: Anthocyanin coloration

Anthocyanin colouration present was recorded for Allahabad Safeda x Apple Colour, Local Red x Dholka, Allahabad Safeda x Dholka, Local Red x Mishri, Allahabad Safeda x Matchless, Allahabad Safeda x Mishri and Allahabad Safeda x Tehsildar. While absent was noted for rest of guava hybrids (Table 3.1). Similar findings were also reported by Santos *et al.* (2012)^[7] and Singh (2013)^[18].

Length of leaf blade

Length of leaf blade was ranged from 10.73 to 15.46 cm. The highest length of leaf blade was noted for Allahabad Safeda x Local Red (15.46 cm). Which was at par with Allahabad Safeda x Chittidar (14.07 cm). The lowest length of leaf blade was recorded for Allahabad Safeda x Mishri (10.73 cm) (Table 3.3). Similar kind of observations are close conformity with the reported by some earlier finder viz., Kumar *et al.* (2012)^[12], Santos *et al.* (2012)^[7], Singh (2013)^[18], Anuragi (2015)^[1], Singh *et al.* (2015)^[19] and Dubey *et al.* (2016)^[6].

Width of leaf blade

Width of blade was ranged from 4.63 to 6.57 cm (Table 3.3). The highest width of leaf blade was recorded for Allahabad Safeda x Local Red (6.57 cm). which was at par with Local Red x Chittidar (6.40 cm), Local Red x Allahabad Safeda (6.27 cm), Allahabad Safeda x Dholka (6.03 cm) and Local

Red x Matchless (6.00 cm) while lowest length of leaf blade was recorded for Allahabad Safeda x Mishri (4.63 cm). The results are in line with earlier findings reported by Kumar *et al.* (2012)^[12], Santos *et al.* (2012)^[7], Singh (2013)^[18], Anuragi (2015)^[1], Singh *et al.* (2015)^[19] and Dubey *et al.* (2016)^[6].

Length/width ratio of leaf blade

Length/width ratio of leaf blade was ranged from 2.06 to 2.69 cm (Table 3.3). The highest length/width ratio of blade was recorded for Allahabad Safeda x Chittidar (2.69 cm). Which was at par with Local Red x Banarasi Surkha (2.43 cm). The lowest length/width ratio of leaf blade was recorded for Local Red x Chittidar (2.06 cm). The results are in line with earlier findings reported by Singh (2013)^[18], Singh *et al.* (2015)^[19] and Dubey *et al.* (2016)^[6].

Shape of leaf

The trullate shape of leaf was recorded for Allahabad Safeda x Local Red, Local Red x Dholka, Allahabad Safeda x Dholka, Allahabad Safeda x Matchless, Allahabad Safeda x Mishri. Whereas oblong shape was recorded for rest of guava hybrids (Table 3.1). Similar kind of variation for leaf shape for different *Psidium* genotypes was also observed by Sharma *et al.* (2010)^[20], Kumar *et al.* (2012)^[12], Singh (2013)^[18], Anuragi (2015)^[1] and Dubey *et al.* (2016)^[6].

Table 3.3: Value of various leaf blade characters of guava hybrids

S. No.	Hybrids	Leaf blade		
		length (cm)	width (cm)	Length/width ratio
1.	Allahabad Safeda x Local Red	15.46	6.57	2.36
2.	Local Red x Allahabad Safeda	13.80	6.27	2.20
3.	Allahabad Safeda x Apple Colour	11.53	5.53	2.08
4.	Allahabad Safeda x Chittidar	14.07	5.23	2.69
5.	Local Red x Chittidar	13.17	6.40	2.06
6.	Local Red x Dholka	11.93	5.23	2.28
7.	Allahabad Safeda x Dholka	12.83	6.03	2.13
8.	Local Red x Banarasi Surkha	13.30	5.50	2.43
9.	Local Red x Mishri	11.67	5.53	2.11
10.	Local Red x Matchless	13.63	6.00	2.32
11.	Allahabad Safeda x Exotica	12.53	5.40	2.32
12.	Allahabad Safeda x Matchless	11.33	4.90	2.32
13.	Allahabad Safeda x Mishri	10.73	4.63	2.31
14.	Allahabad Safeda x Tehsildar	12.30	5.30	2.32
	S.Em. \pm	0.53	0.29	0.10
	C.D. @ 5%	1.52	0.83	0.29
	C.V. %	7.16	8.84	7.70

3.1 Variance component

The genotypic variance contributing to phenotypic variance was moderate (1.35 and 2.18) for length of leaf blade and length/width ratio of blade (0.02 and 0.05). This indicated that phenotypic variance was mainly due to genotypic and environment, both whereas Major part of phenotypic variance was shared by genotypic variance for width of leaf blade (0.24 and 0.49). Thus, results indicated that variation due to error component was less in the trait.

3.2 Genotypic and phenotypic coefficient of variation

Low estimate of GCV and PCV indicated the existence of low variability for length of leaf blade (GCV 9.11% and GCV 11.59%) and length/width ratio of leaf blade (GCV 5.70% and PCV 9.58%). Least difference between GCV and PCV values suggested less contribution of the environment for the expression of the character whenever values of GCV (8.76%) and PCV (12.45%) was lower to moderate indicated the existence of moderate amount of variability for width of leaf blade. Least difference between GCV and PCV values suggested less contribution of the environment for the expression of the character.

4. Conclusion

Study of morphological parameters revealed that guava (*Psidium guajava* L.) hybrids possess wide range of length of leaf blade ranging from 10.73 cm (Allahabad Safeda x Mishri) to 15.46 cm (Allahabad Safeda x Local Red) with an average of 12.73 cm and width of leaf blade ranging from 4.63 cm (Allahabad Safeda x Mishri) to 6.57 cm (Allahabad Safeda x Local Red) with an average of 5.61 cm. Length/width ratio of leaf blade ranged from 2.06 cm (Local Red x Chittidar) to 2.69 cm (Allahabad Safeda x Chittidar) with an average of 2.28 cm. Variability component study revealed that, existence of sufficient amount of variability among these guava (*Psidium guajava* L.) hybrids. The characters like length of leaf blade, width of leaf blade possessed genotypic variance predominant in the expression of the phenotypic variance of study. This suggested that this characters were influenced by genotypic factors whereas length/width ratio of leaf blade is governed by both genotypic as well as environmental factors. The estimate of GCV and PCV were found to be low for length of leaf blade, length/width ratio of leaf blade suggesting that hybrids were

not differing much for these characters whereas moderate GCV and PCV were recorded for width of leaf blade, suggesting that hybrids were moderate differing for this characters.

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