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Characterization and Evaluation of Ridge Gourd [*Luffa acutangula* (Roxb.) L.] Germplasm

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Fifty one ridge gourd germplasm were evaluated for yield and qualitative traits during 2011-14. There were significant differences among the germplasm for all the 11 quantitative and nine out of 22 qualitative parameters studied. Regarding plant growth habit, 34 had long vines, 16 had medium long vines and only one germplasm, IC92618 had short vines. Fifteen germplasm lines recorded dark green fruit skin colour, 33 had green coloured fruits and only three germplasm had light green coloured fruits, hence this variability can be exploited for developing green and dark green coloured varieties which are very much preferred in different markets. With respect to fruit taste, 29 lines had normal fruit taste, 18 lines were sweet and four lines, viz., IC92625, IC92685, IIHR-17 and IIHR-51 had bitter fruits. Among the germplasm evaluated, IC20404 (5.2 and 41.3) showed earliness in terms of node number as well as days for appearance of first female flower followed by IC23259 (6.0 and 41.2). Arka Sumeet and Co-1 recorded highest fruit length and fruit weight which are the important yield contributing fruit parameters. IIHR-21 recorded the highest mean value for fruit yield per vine (2.8 kg) followed by IIHR-6 (2.6 kg). This variability present among the germplasm evaluated for yield and quality parameters can be effectively utilized for the improvement of ridge gourd, with IIHR-6 and IIHR-21, the most promising germplasm as common parents and 'Arka Sumeet' and 'CO-1' as partners to develop character specific hybrids with maximum yield potential.

Key Words: Characterization, Evaluation, *Luffa acutangula* (Roxb.) L, Ridge gourd, Yield

Introduction

Ridge gourd [*Luffa acutangula* (Roxb.) L.] is an important cucurbitaceous summer vegetable of South East Asia and few African countries. The young tender fruits of the non-bitter types are eaten fresh like cucumbers, cooked as a vegetable or used in soups. Fruits of *Luffa* are very nutritious and good source of vitamin A, calcium, phosphorus, ascorbic acid and iron. Despite its economic importance and presence of considerable variability, development of varieties/hybrids in ridge gourd is rather limited. Identification of superior genotypes among the existing germplasm becomes imperative for promoting yield and yield related traits. Hence, collection and evaluation of germplasm is a pre-requisite for their utilization. Detailed evaluation of germplasm collected over the years determines the potential of a germplasm in specific crop improvement programme. Therefore, a trial for characterization and evaluation of presently available ridge gourd germplasm at ICAR-Indian Institute of Horticultural Research (ICAR-IIHR), Bengaluru was carried out in order to identify the potential genotypes for different horticultural characters.

Material and Methods

The experiments were carried out at the Vegetable Farm, ICAR-IIHR during rabi-summer seasons of 2011-12, 2012-13 and 2013-14. The experiments were laid out in Randomized Block Design with 51 germplasm lines in two replications in all the three years. Ten plants per replication were raised. Two weeks old seedlings were planted at 150 × 50 cm spacing on single trelly system. The recommended agronomical practices were adopted to raise the crop. Observations were recorded on five randomly selected plants from each replication on 22 morphological traits pertaining to plant, leaf and fruit as per the NBPGR Minimal Descriptor (Srivastava *et al.*, 2001) and on 11 quantitative traits such as node number for first female flower appearance, days taken for first female flower appearance, vine length (m), branch number, peduncle length (cm), fruit length (cm), fruit girth (cm), fruit weight (g), fruit number/vine, fruit yield/vine (kg) and fruit yield/ha (t). The pooled data of three years were analysed as suggested by Panse and Sukhatme (1984) for analysis of variance.

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Results and Discussion

Qualitative Traits of Ridge Gourd Germplasm

Qualitative characteristics of 51 germplasm of ridge gourd are presented in Table 1. Wide variability was observed for nine out of 22 qualitative traits studied among the ridge gourd germplasm such as early plant vigour, plant growth habit, leaf size, leaf pubescence nature, fruit skin colour, fruit skin luster, fruit ridge (rib) shape, seediness and fruit taste. Good early plant vigour helps in better establishment and development of good frame work of the plant which results in more flowers, fruits and ultimately high yield. In the present study, 29 germplasm had very good early plant vigour, 17 had good vigour where as only 5 germplasm lines were poor in early plant vigour (Table 1). Regarding plant growth habit, 34 had long vines, 16 had medium long vines and only one germplasm, IC92618 had short vines. Leaf size was large in 30 germplasm, medium in 20 lines and small in only one germplasm i.e., IC92618. Hard leaf pubescence was observed in 30 germplasm, where as it was intermediate in 21 lines. The fruit skin colour was light-green, green and dark-green (Table 1). Fifteen germplasm lines recorded dark-green fruit skin colour, 33 had green colour fruits and only three germplasm had light-green colour fruits. In general green and dark-green coloured varieties are preferred in the market; hence the variability for fruit skin colour present in this collection can be exploited for developing such varieties in ridge gourd. Fruit skin luster is important in ridge gourd and matt type fruits are preferred in the market than the glossy types. Sufficient variability for this trait was present among the germplasm and about 23 germplasm recorded matt type, 21 had intermediate and only seven were with glossy fruit skin lustre.

Ridges on fruit surface are significant as the deep grooved fruits will have the strength to withstand

Table 1. Frequency distribution (%) of morphological traits of ridge gourd germplasm

S. No.	Morphological trait	Stage of observation recorded	Class	Germplasm (no.)	Frequency
1	Early plant vigour	After 30 days of sowing	Poor	5	9.8
			Good	17	33.3
			Very good	29	56.9
2	Plant growth habit	At fully grown plant	Short viny	1	2.0
			Medium viny	16	31.4
			Long viny	34	66.7
3	Leaf size	At full foliage stage	Small	1	2.0
			Medium	30	58.8
			Large	20	39.2
4	Leaf pubescence	At full foliage stage	Soft	0	0.0
			Intermediate	21	41.2
			Hard	30	58.8
5	Fruit skin colour	At marketable stage	Light green	3	5.9
			Green	33	64.7
			Dark green	15	29.4
6	Fruit skin luster	At marketable stage	Matt	23	45.1
			Intermediate	21	41.2
			Glossy	7	13.7
7	Fruit ridge (rib) shape	In cross-section at marketable stage	Superficial	9	17.6
			Rounded/grooved	0	0.0
			Intermediate	17	33.3
			Deep grooved	25	49.0
8	Seediness	At marketable stage	Low	20	39.2
			Medium	19	37.3
			High	12	23.5
9	Fruit taste	At marketable stage	Normal	29	56.9
			Sweet	18	35.3
			Bitter	4	7.8

long distance transport on one hand and on the other hand, superficial ridge shaped fruits are preferred by the consumers with minimum wastage while peeling the fruits. In the present investigation, majority of the germplasm (25) were deep grooved, followed by intermediate (17) and nine germplasm had superficial ridge shape. Low seediness is preferred in any gourd vegetable and 20 out of 51 germplasm had this trait, 19 had medium seediness and 12 germplasm had high seediness. Similar variability for most of the qualitative traits was observed among the 55 germplasm lines of ridge gourd evaluated by Mahajan *et al.* (2005). Fruit taste is a very important qualitative trait, as cucurbits are known for the presence of the bitter principle (cucurbitacin). This bitterness poses a serious problem by contaminating other sweet lines also through their pollen (metaxenia) thus, making them also bitter. In the present study, 29 lines had normal fruit taste, 18 lines were sweet and four lines, viz. IIHR-17, IC92625, IC92685 and IIHR-51 had bitter fruits and thus these four lines are unfit for commercial utilisation.

Quantitative Traits of Ridge Gourd Germplasm

The analysis of variance revealed significant differences among the 51 germplasm lines in ridge gourd for all the 11 traits studied (Table 2). The results of 47 germplasm lines are discussed excluding the four bitter fruited germplasm. Wide range of variation was observed for most of the characters like days taken for first female flower appearance (37.0-66.4), fruit length (10.5-41.3 cm), fruit number/plant (4.7-33.8), fruit weight (79.8-300.8 g) and fruit yield/ha (8.5-37.9 t). Presence of such high variability for these parameters will form the basis for effective selection of superior lines in ridge gourd. Such wide variability for many quantitative traits was reported earlier by Varalakshmi *et al.* (1995), Choudhary and Suresh Kumar (2011) and Rabbani *et al.* (2012) in ridge gourd. Earliness is a desirable trait and among the germplasm evaluated, IC20404 (5.2 and 41.3) showed earliness in terms of node number as well as days for appearance of first female flower which was followed by IC23259 (6.0 and 41.2). Similar results were observed by Krishna Prasad and Singh (1989) during the evaluation of ridge gourd germplasm.

Significant differences were observed for plant characters among the germplasm lines with the germplasm IIHR-6 and IIHR-14 (5.6 m) recording the longest vines followed by IIHR-2 (5.5 m). Varghese (1991) also found variability in vine length among 48 snake gourd genotypes. Maximum branch number was recorded by IIHR-7 (13) followed by IIHR-2 (11) which can have more flowers and fruit set. Significant differences were observed among the germplasm lines for all the fruit traits. Arka Sumeet had longest fruits (41.3cm) followed by Rekha (40.9 cm) and Co-1(37.1 cm). Maximum fruit girth (16.9 cm) was recorded by IC308561 followed by IC344652 (15.5 cm). However, some times, minimum fruit girth at marketable maturity is a preferred trait and in this direction, IIHR-14 (8.1cm) had very thin fruits. Similar variation in fruit characters was observed in bottle gourd by Suganthi (2008). Weight of a single fruit determines the overall yield performance of a vine and among the germplasm studied, Arka Sumeet (300.8 g) recorded highest fruit weight followed by Mallika (267.2 g) and Co-1 (260.8 g). Similar variability for fruit weight was reported by Alli Rani and Jansirani (2014) in ridge gourd.

Number of fruits per vine is an important character which directly contributes to higher yield and significant difference was observed for fruit number per vine among the germplasm studied. Based on the mean performance, the genotype IC110893, which is an andro-monoecious line, had higher number of fruits per vine (33.8) followed by IC308562 (24.1). Similar findings for differential fruit number by the germplasm were reported by Suganthi (2008) and Hitesh *et al.* (2012) in bottle gourd and Coccinia respectively. In the present study, among the 51 germplasm, IIHR-21 and two hybrids, NS-03 and Mallika recorded the highest mean value for fruit yield per vine (2.8 kg) followed by IIHR-6 (2.6 kg). Similar findings for variability in fruit yield per vine were reported by Hitesh *et al.* (2012) in ivy gourd and by Alli Rani and Jansirani (2014) in ridge gourd.

Selection of genotypes with the highest fruit yield is the primary objective in any crop improvement programme. Among 51 germplasm evaluated, IIHR-21 recorded the highest fruit yield/ha (37.9 t) followed by IIHR-6 with mean fruit yield of 34.8 t/ha. These germplasm can be used as one of the parents for developing hybrids with high yield potential in ridge gourd. This study clearly indicated that varieties/hybrids could be developed with earliness, higher fruit length and more fruits per vine with higher yield potential in ridge gourd.

Table 2. Performance of ridge gourd germplasm with respect to 11 quantitative traits during 2011-14

S.No.	Germplasm	NFF	DFF	Vine length (m)	Branch number	Peduncle length (cm)	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Fruit number/ vine	Fruit yield/ vine (kg)	Fruit yield/ ha (t)
1	IC92700	8.2	47.5	4.3	5.4	7.0	22.3	10.0	142.7	22.9	1.7	23.2
2	IC20404	5.3	41.2	3.8	5.0	5.4	14.1	10.6	101.1	18.0	1.0	14.1
3	IC92624	7.9	49.9	2.6	2.9	7.4	20.0	10.0	120.4	18.5	1.5	18.6
4	IC105554	8.8	44.1	3.6	5.9	6.9	15.3	11.2	120.5	19.0	2.0	28.4
5	IC23255	8.4	42.3	2.7	4.8	7.3	20.4	10.6	141.7	8.9	1.3	17.0
6	IC339224	7.7	44.8	3.4	4.2	6.4	18.1	10.0	151.8	12.9	1.7	22.0
7	IC23259	6.0	41.2	3.5	5.4	7.3	17.1	10.6	123.7	15.6	1.5	21.8
8	IC92637	7.7	39.2	3.4	5.8	7.1	18.0	10.4	130.1	21.6	1.7	26.9
9	IC92689	6.2	46.0	3.0	4.2	6.5	18.4	10.7	153.1	7.8	0.6	8.6
10	IC92618	7.1	42.9	2.8	3.9	6.4	16.6	11.4	112.2	16.7	1.9	23.7
11	IC93393	13.9	48.7	2.9	3.9	9.3	21.9	11.9	163.2	9.9	1.7	20.9
12	IC392334	7.4	47.9	3.6	4.8	8.0	16.1	10.8	143.9	16.7	1.8	25.1
13	IC308562	6.9	44.8	3.2	4.9	6.2	13.2	9.7	100.1	24.1	1.8	26.2
14	IC385911	9.2	45.2	3.8	9.0	8.7	24.4	10.8	175.3	15.4	2.3	31.5
15	IC385912	9.1	45.5	3.5	4.8	7.8	12.2	12.0	118.8	18.8	1.8	23.4
16	IC92622	7.0	37.0	3.5	4.5	7.2	15.8	15.0	117.9	12.4	2.5	19.6
17	IC105579	7.3	48.1	3.6	6.4	7.6	18.4	14.3	151.7	15.9	1.7	23.6
18	IC110893	10.8	40.9	3.1	3.3	4.9	10.5	12.9	80.1	33.8	1.8	23.9
19	IC146606	8.7	46.6	3.0	13.3	5.7	16.7	14.2	116.4	14.6	1.3	19.9
20	IC201145	6.8	46.8	3.1	8.4	7.8	17.2	14.6	149.5	14.4	1.6	25.4
21	IC308561	7.5	41.2	2.2	3.0	5.8	11.4	16.9	100.6	18.1	1.3	16.4
22	IC344652	8.1	49.5	3.8	7.9	8.8	22.0	15.5	168.7	9.8	1.6	20.3
23	IC146589	8.3	49.4	3.5	6.0	7.1	16.1	13.0	114.2	17.5	1.8	23.7
24	IC369441	8.7	46.7	2.9	4.2	7.0	13.4	12.7	100.2	21.3	1.6	21.7
25	IC395846	9.8	56.0	2.8	6.5	6.6	13.0	13.5	131.1	12.3	1.5	20.0
26	IIHR-1	9.9	47.8	4.2	9.3	7.4	23.6	10.5	185.7	16.5	2.2	27.0
27	IIHR-2	10.0	46.4	5.5	11.0	10.7	32.2	10.7	235.6	14.3	1.9	25.6
28	IIHR-6	11.5	48.8	5.6	9.4	10.8	31.9	10.1	228.7	11.7	2.6	34.8
29	IIHR-7	17.8	53.7	5.2	13.0	8.3	23.7	10.9	214.3	5.1	0.9	12.1
30	IIHR-10	10.1	49.4	3.8	9.8	7.6	25.7	10.2	181.9	11.3	1.7	21.7
31	IIHR-12	10.1	46.6	3.7	6.0	7.9	26.6	10.8	188.9	9.3	1.8	23.1
32	IIHR-13	10.7	52.8	3.3	5.0	9.8	25.2	9.7	189.3	12.6	2.0	29.0
33	IIHR-14	15.3	59.1	5.6	6.0	7.8	22.1	8.1	214.8	7.3	1.2	15.7
34	IIHR-15	11.4	49.7	3.1	7.1	8.1	27.7	10.7	174.1	9.3	1.7	23.3
35	IIHR-16	9.6	49.3	3.3	7.2	8.3	25.8	10.4	172.1	13.3	1.8	25.2
36	IIHR-21	8.6	48.7	4.4	6.4	10.3	28.8	10.6	219.4	14.1	2.8	37.9
37	IIHR-22	8.7	50.6	3.9	11.4	8.6	26.3	10.0	210.3	10.8	2.1	28.2
38	IIHR-53	9.5	46.0	4.5	9.9	10.3	33.6	14.6	244.4	8.4	2.0	26.4
39	Pusa Nasdar	12.6	51.1	5.4	10.5	10.8	29.5	10.6	224.4	6.3	1.4	19.8
40	Arka Sumeet	15.6	55.2	5.0	11.3	9.6	41.3	11.0	300.8	5.7	1.5	20.6
41	Arka Sujat	14.9	54.7	4.4	9.7	9.5	28.5	10.9	234.6	7.7	1.5	19.6
42	CO-1	12.4	60.6	5.0	10.6	12.7	37.1	15.0	260.8	4.7	1.2	15.3
43	Rekha	12.6	54.0	4.5	6.9	12.2	40.9	10.3	241.5	9.7	2.6	31.7
44	Mallika	8.5	41.8	5.0	6.2	11.7	33.5	11.2	267.2	12.4	2.8	36.6
45	NS-3	9.5	42.3	4.3	6.4	11.4	32.7	11.7	258.9	13.4	2.8	37.0
46	Naga	9.5	48.3	5.0	10.8	8.1	12.4	13.4	102.8	18.1	2.1	27.1
47	Malav-11	12.2	44.5	4.1	9.3	7.3	24.6	13.9	174.5	8.7	1.4	17.6
48	IIHR-17	20.0	66.4	6.5	8.9	8.9	25.5	9.9	237.5	5.3	1.3	14.4
49	IC-92625	8.3	49.0	3.4	4.2	7.6	15.2	15.1	154.8	10.0	1.5	17.9
50	IC-92685	6.4	42.2	2.9	3.0	5.5	13.8	13.1	79.8	17.7	1.5	19.4
51	IIHR-51	10.3	38.7	5.9	5.9	11.1	36.4	13.9	234.1	11.7	2.8	37.1
	Mean	9.8	47.7	3.9	6.9	8.2	22.5	11.8	169.8	13.6	1.8	23.3
	Sig.	**	**	**	**	**	**	**	**	**	**	**
	CD at 0.01	2.0	6.1	0.9	1.5	1.7	4.6	2.8	37.5	4.3	0.5	6.1
	CV %	17.6	11.2	20.0	19.0	18.3	18.1	20.9	19.4	28.2	22.8	22.9

** Significant at P=0.01; NFF- Node number for first female flower appearance; DFF- Days taken for first female flower appearance

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