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Research Note

Mean performance of parents and hybrids for growth and yield attributing traits in ridge gourd (*Luffa acutangula* (L.) Roxb.)

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Abstract
The present investigation were carried out to know the mean performance of parents and hybrids for growth and yield attributing traits in ridge gourd at College of Horticulture, Venkataramannagudem, during 2018-19. Among the ten parents used for study VRG-11, Swarna Manjari, VRG-13 and VRG-24 were high yielding of 3.31, 2.61, 2.49 and 1.66 kg per vine, respectively. The hybrids VRG-24 x VRG-13, VRG-24 x VRG-16, Swarna Manjari x Arka Prasan and Swarna Manjari x VRG-16 recorded the highest yield of 4.83, 4.25, 3.80 and 3.78 kg per vine, respectively in ridge gourd. The hybrid VRG-11 x Swarna Manjari was most promising for the trait which contribute to the highest yield per vine that is days to first female flower appearance. Based on their mean performance parents can be used for further breeding programmes and hybrids could be exploited for cultivation.

Key words
Ridge gourd, (*Luffa acutangula* (L.) Roxb.) Mean performance, Yield, Hybrids.

Ridge gourd (*Luffa acutangula* (L.) Roxb.) belongs to the family Cucurbitaceae and genus *Luffa*. Its chromosome number is 2n=2x=26. It is also called as angled gourd, angled loofah, Chinese okra, silky gourd and ribbed gourd (Muthaiah *et al*., 2017). Gourds are the important vegetables in the human diet especially in India. The tender green or immature fruits are cooked as vegetable and used in preparations of chutney and curries. The area under ridge gourd in India is 90,000 hectares and the production is 983 metric tonnes (Anon, 2016). It is considered to be the old world species and is native of tropical Africa and South-East Asian region including India.

Ridge gourd being monoecious in sex expression can be profitably utilized for the production of F_1 hybrid seeds at cheaper rates, as the monoecious nature of crop eliminates emasculation and higher number of hybrid seeds per cross make it more economical. Further, the crop being cultivated at wider spacing, the hybrid seed rate per hectare for commercial vegetable cultivation would be low and cost effective. Thus, ridge gourd offers greater scope for exploitation of hybrid vigour on commercial scale to increase the production/productivity. The genotypes performing well can be released as a variety or can be used further in heterosis breeding programme.

The experimental material consisted of ten parental lines *viz.,* VRG-11, VRG-23, VRG-24, VRG-25, Swarna Manjari, Arka Prasan, VRG-13, VRG-14, VRG-15 and

VRG-16 of these were crossed in diallel fashion excluding reciprocals during *Rabi*, 2018. The resultant 45 F_1 hybrids along with ten parents and two checks were evaluated in randomized block design with two replications with spacing of 1.2 x 1.0 m during *Summer*, 2019. Observations were recorded on five randomly selected plants from each plot for growth and yield attributing traits *viz.,* days to first male and female flower appearance, node number at which first male and female flower appear, sex ratio, intermodal length (cm), days to first fruit harvest, the number of fruits per vine, fruit diameter (cm), fruit length (cm), fruit flesh thickness (mm), average fruit weight (g), the number of seeds per fruit, fruit yield per vine (kg) to see the mean performance of parents and hybrids.

In the analysis of mean squares the differences due to the treatments were significant for all the characters studied except for the days to first male flower appearance, days to first female flower appearance, internodal length and days to first fruit harvest (**Table 1**.). The treatment mean was further sub divided into parents, hybrids and parents versus hybrids. The parents showed significant difference for all the characters studied except for the days to first male flower appearance, days to first female flower appearance, node number at which first female flower appear, internodal length, days to first fruit harvest and fruit diameter. The hybrids showed significant difference for all the characters studied except for the days to first male flower appearance, days to first female flower appearance, internodal length and days to first fruit harvest. The parents versus hybrids showed significant differences for the characters internodal length, fruit length, fruit flesh thickness, the number of seeds per fruit and other characters are non significant.

Table 1. Analysis of variance for growth and yield attributing traits in 10x10 half diallel of ridge gourd

Source	Df	Days to first male flower appearance	Days to first female flower appearance	Node number at which first male flower appear	Node number at which first female flower appear	Sex ratio	Internodal length (cm)	Days to first fruit harvest	Number of fruits per vine
				Mean Sum of Squares					
Treatments	54.00	1.50	9.72	0.34 **	3.65 **	24.54 **	7.08	1.46	9.69 **
Parents	9.00	0.50	3.41	0.52 **	1.69	20.95 **	4.60	2.57	6.35 *
Hybrids	44.00	1.78	11.01	0.31 **	4.07 **	25.81 **	6.60	1.25	10.52 **
Parent Vs. Hybrid	1.00	0.16	9.56	0.41	3.14	1.15	50.62 **	0.77	3.29
Error	54.00	1.16	13.37	0.06	1.46	5.07	6.04	3.49	2.56

Table 1.Cont…

Source	Df	Fruit diameter (cm)	Fruit length (cm)	Fruit flesh thickness (mm)	Average fruit weight (g)	Number of seeds per fruit	Fruit yield per vine (kg)
				Mean Sum of Squares			
Treatments	54.00	3.80 *	38.95 **	11.66 **	4311.67 **	2811.96 **	0.94 **
Parents	9.00	3.84	21.75 *	9.38 **	2824.90 **	570.04 **	0.42 **
Hybrids	44.00	3.88 *	40.86 **	11.04 **	4713.69 **	3050.49 **	1.07 **
Parent Vs. Hybrid	1.00	0.23	110.03 **	59.86 **	3.70	12493.63 **	0.02
Error	54.00	2.29	9.55	0.00	299.61	48.05	0.09

* and ** Significance at 5% and 1% level respectively.

The results from *per se* performance of parents and hybrids revealed that, the parents took 28.60 (VRG-23) to 30.00 (VRG-11), 33.50 (VRG-14) to 37.80 (Swarna Manjari) and the cross combinations took 27.00 (VRG-11 x Swarna Manjari) to 32.90 (Swarna Manjari x VRG-13), 20.30 (VRG-11 x Swarna Manjari) to 36.00 (VRG-23 x VRG-16) for days to first male and female flower appearance, respectively (**Table 2**.). Similar results are reported by Abusaleha and Dutta (1994) and Hedauand Sirohi (2004). For the character node number at which first male and female flower appear, the parents took 1.65 (VRG-23) to 3.40 (Arka Prasan), 8.80 (VRG-14) to 11.80 (Swarna Manjari) and the cross combinations took 1.50 (VRG-24 x Arka Prasan) to 3.30 (Swarna Manjari x VRG-13), 6.40 (VRG-11 x VRG-14) to 13.00 (VRG-25 x VRG-13) respectively (Table 2.). Similar results are reported by Rao *et al*. (2000) in ridge gourd. For the character sex ratio and intermodal length, the parents took 17.02

Table 2. Per se performance of parents and hybrids for growth and yield attributing traits in 10x10 half diallel of ridge gourd

Pedigee/Cross	Growth parameters							Yield parameters						
	DFMFA	DFFFA	NNFMFA	NNFFFA	SR	IL	DFFH	NFV	FD	FL	FFT	AFW	NSF	FYV
VRG-11 X VRG-23	28.70	34.90	2.55	11.00	20.74	15.30	41.00	9.40	13.30	20.95	8.03	122.85	9.40	2.77
VRG-11 X VRG-24	27.98	35.90	2.30	11.20	21.50	15.90	42.00	7.70	14.15	15.30	9.53	132.37	7.70	2.59
VRG-11 X VRG-25	29.70	35.40	2.30	9.50	21.50	18.70	41.80	11.50	12.78	22.65	5.03	136.83	11.50	2.10
VRG-11 X Swarna Manjari	27.00	20.30	1.90	11.50	21.75	17.60	41.80	11.70	15.65	12.90	10.13	130.33	11.70	2.40
VRG-11 X Arka Prasan	29.00	33.80	2.30	10.50	24.78	17.20	40.70	11.30	14.75	23.30	7.86	153.95	11.30	2.73
VRG-11 X VRG-13	29.10	36.50	2.30	9.40	26.00	19.00	42.40	13.10	12.30	15.65	10.05	108.30	13.10	1.65
VRG-11 X VRG-14	28.50	35.40	2.05	6.40	27.30	19.20	41.40	9.60	13.35	19.68	12.17	101.08	9.60	2.36
VRG-11 X VRG-15	28.40	35.20	1.90	8.50	27.30	19.50	41.80	9.50	12.70	18.25	8.17	119.05	9.50	2.17
VRG-11 X VRG-16	29.00	35.60	2.00	9.90	22.85	19.70	41.90	8.40	14.52	22.10	9.85	103.45	8.40	2.46
VRG-23 X VRG-24	29.70	36.40	1.95	10.70	21.12	15.30	42.70	11.80	15.35	18.93	11.85	120.25	11.80	2.04
VRG-23 X VRG-25	28.90	35.40	1.70	10.90	19.35	21.10	41.80	10.30	9.28	19.95	6.88	122.50	10.30	2.46
VRG-23 X Swarna Manjari	28.70	35.60	2.70	8.40	18.20	19.00	41.70	10.00	15.60	20.80	8.42	135.00	10.00	2.33
VRG-23 X Arka Prasan	27.68	36.10	1.70	7.60	17.18	20.70	42.30	12.00	12.85	18.25	5.87	118.86	12.00	2.23
VRG-23 X VRG-13	28.50	35.20	1.85	6.60	25.04	18.80	41.20	14.90	14.30	17.65	11.25	112.12	14.90	1.50
VRG-23 X VRG-14	29.90	34.90	1.90	7.70	19.85	18.10	41.40	10.30	16.15	19.40	11.10	108.75	10.30	2.13
VRG-23 X VRG-15	29.00	34.10	2.35	8.55	26.88	21.30	40.00	10.80	11.30	20.60	6.39	110.66	12.80	1.74
VRG-23 X VRG-16	30.00	36.60	3.10	10.40	23.08	18.00	43.00	15.20	13.15	27.45	9.48	112.00	15.20	1.47
VRG-24 X VRG-25	29.30	35.30	1.60	12.82	24.78	19.10	41.50	15.20	14.50	24.70	8.20	142.50	15.20	2.06
VRG-24 X Swarna Manjari	29.20	35.00	2.15	8.90	26.04	18.40	41.00	13.60	14.60	21.40	13.19	162.70	13.60	2.49
VRG-24 X Arka Prasan	28.90	35.20	1.50	9.00	18.74	18.00	41.70	13.90	13.80	25.55	9.63	145.00	13.90	1.98
VRG-24 X VRG-13	28.40	34.80	2.30	10.20	20.27	17.00	42.10	14.00	14.92	38.10	3.11	334.33	14.00	4.83
VRG-24 X VRG-14	28.40	33.80	1.90	9.80	28.51	17.40	40.40	12.50	14.15	21.00	14.18	114.55	12.50	2.01
VRG-24 X VRG-15	29.90	35.30	2.20	9.80	27.85	22.30	41.80	12.70	12.90	23.25	8.19	207.53	12.70	2.71
VRG-24 X VRG-16	28.30	34.60	2.65	9.50	22.27	19.60	41.20	9.20	13.40	29.00	6.74	238.30	9.20	4.25
VRG-25 X Swarna Manjari	28.60	36.30	1.80	8.10	19.25	19.60	42.40	18.70	12.10	21.95	6.83	102.75	18.70	1.11
VRG-25 X Arka Prasan	29.10	35.90	2.20	9.90	18.54	20.70	42.30	12.40	13.25	22.65	6.05	153.16	12.40	2.06
VRG-25 X VRG-13	30.50	35.00	1.80	13.00	17.56	20.60	40.70	11.80	13.30	18.30	9.17	122.62	11.80	2.08
VRG-25 X VRG-14	29.20	34.00	1.60	11.10	19.18	19.30	42.30	12.40	15.95	19.80	10.35	160.62	12.40	2.60
VRG-25 X VRG-15	29.40	34.00	2.05	10.50	17.21	25.00	40.10	15.60	10.37	16.00	13.79	99.00	15.60	1.44
VRG-25 X VRG-16	29.60	34.75	1.70	9.70	16.48	19.80	40.80	11.00	13.60	19.40	11.29	118.96	11.00	2.16
Swarna Manjari X Arka Prasan	28.90	35.20	1.70	7.80	24.02	19.80	41.70	9.90	13.45	27.40	7.19	161.50	9.90	3.80
Swarna Manjar X VRG-13	32.90	33.50	3.30	10.50	23.08	19.00	41.60	10.50	14.35	22.15	8.72	146.58	10.50	2.90
Swarna Manjari X VRG-14	30.30	35.80	1.90	9.00	27.30	19.70	41.60	11.70	14.40	17.80	10.79	152.00	11.70	2.39
Swarna Manjari X VRG-15	29.30	34.50	1.70	10.40	19.18	21.10	42.10	10.20	13.95	18.55	11.48	135.60	10.20	2.36
Swarna Manjari X VRG-16	30.50	33.80	2.25	10.20	24.78	20.30	41.10	12.20	11.90	30.50	8.33	274.25	12.20	3.78
Arka Prasan X VRG-13	29.00	33.90	1.60	10.40	20.74	19.10	39.80	12.00	13.39	23.55	9.56	212.50	12.00	2.70
Arka Prasan X VRG-14	29.10	35.90	2.20	7.70	17.18	19.80	41.70	11.30	13.05	28.40	5.93	156.40	11.30	3.06
Arka Prasan X VRG-15	27.90	33.80	2.40	9.50	26.88	21.50	40.30	10.60	13.10	19.90	10.13	115.80	10.60	2.18
Arka Prasan X VRG-16	29.50	33.70	1.70	8.10	17.02	21.10	39.70	14.50	13.18	18.35	8.79	101.66	14.50	1.40
VRG-13 X VRG-14	29.70	35.40	2.10	11.00	23.52	18.80	41.50	9.10	11.85	23.20	7.03	128.87	9.10	3.11
VRG-13X VRG-15	30.00	34.70	2.20	10.10	21.18	21.50	41.00	15.20	12.60	22.05	7.53	104.00	15.20	1.37
VRG-13 X VRG-16	29.40	35.40	2.50	9.90	19.56	20.70	41.60	13.30	12.85	22.50	7.16	155.35	13.30	2.46
VRG-14 X VRG-15	30.50	33.90	2.70	10.90	17.56	19.70	40.00	14.20	12.85	25.40	7.20	130.86	14.20	2.01
VRG-14 X VRG-16	28.40	35.60	2.30	8.70	16.48	21.40	42.10	16.10	15.45	24.90	7.78	233.25	16.10	2.23
VRG-15 X VRG-16	29.20	34.50	2.20	8.60	19.35	19.70	41.90	13.50	12.85	23.90	11.01	158.00	13.50	2.07
Hybrid mean	29.18	34.69	2.11	9.64	21.75	19.03	41.44	12.11	13.50	21.92	8.92	144.82	12.15	2.37
VRG-11	30.00	34.70	2.55	10.90	19.54	20.80	41.00	14.90	14.53	24.54	6.49	246.12	14.90	3.13
VRG-23	28.60	34.60	1.65	9.50	25.11	24.80	40.90	15.30	12.75	19.50	7.64	147.75	15.30	1.66
VRG-24	28.90	34.70	2.30	9.70	18.68	20.60	41.60	14.30	10.15	23.35	8.19	129.20	14.30	1.66
VRG-25	29.80	34.50	1.70	9.30	22.62	20.50	40.50	13.00	14.35	21.30	8.34	130.20	13.00	2.36
Swarna Manjari	29.20	37.80	2.20	11.80	19.56	22.30	43.40	10.80	12.75	26.20	6.27	140.37	10.80	2.61
Arka Prasan	29.90	36.00	3.40	10.40	22.85	19.20	42.30	11.30	15.20	21.20	10.82	111.70	11.30	2.04
VRG-13	29.00	35.50	1.80	9.60	17.02	21.00	41.70	12.70	13.05	30.10	4.87	147.91	12.70	2.49
VRG-14	29.60	33.50	2.56	8.80	26.02	20.50	39.80	10.50	13.80	26.30	5.83	127.33	10.50	2.70
VRG-15	28.80	37.00	2.25	11.00	22.40	20.40	43.00	12.50	13.45	24.55	8.50	121.62	12.50	2.19
VRG-16	29.00	36.20	2.30	9.80	26.40	21.80	42.40	10.70	13.85	28.10	3.12	148.54	10.70	2.52
Parent mean	29.28	35.45	2.27	10.08	22.02	21.19	41.66	12.60	13.39	24.51	7.01	145.07	12.60	2.34
Aarti	29.00	33.10	2.50	10.30	21.75	18.40	41.80	9.00	15.96	19.50	6.02	121.79	9.00	3.14
Chitra	28.40	33.60	2.60	10.10	26.40	13.80	40.30	14.50	13.80	27.90	11.23	171.37	14.50	2.36
Check mean	28.70	33.35	2.55	10.20	24.08	16.10	41.05	11.75	14.88	23.70	8.63	146.58	11.75	2.75
Grand mean	29.18	34.77	2.15	9.73	21.88	19.62	41.46	12.21	13.53	22.43	8.57	144.75	12.21	2.38
SE±m	0.76	2.60	0.17	0.84	1.57	1.70	1.32	1.13	1.06	2.14	0.06	12.28	1.13	0.22
C. D at 5%	NS	NS	0.49	2.39	4.45	NS	NS	3.22	3.01	6.08	0.18	34.81	3.22	0.64
C. D at 1%	NS	NS	0.65	3.18	5.92	NS	NS	4.29	4.00	8.09	0.24	46.33	4.29	0.86

DFMFA= Days to first male flower appearance, DFFFA= Days to first female flower appearance, NNFMFA= Node number at which first male flower appear, NNFFFA= Node number at which first female flower appear, SR= Sex ratio, IL= Internodal length, DFFH= Days to first fruit harvest, NFV= Number of fruits per vine, FD= Fruit diameter, FL= Fruit length, FFT= Fruit flesh thickness, AFW= Average fruit weight, NSF= Number of seeds per fruit, FYV= Fruit yield per vine.

(VRG-13) to 26.40 (VRG-16), 19.20 (Arka Prasan) to 24.80 (VRG-23) and cross combinations took 16.48 (VRG-25 x VRG-16) to 28.51 (VRG-24 x VRG-14), 15.30 (VRG-11 x VRG-23) to 25.00 (VRG-25 x VRG-15) respectively (Table 2.). Similar results were reported by Kalimani (2004) in bitter gourd. For days to first fruit harvest, parents took 39.80 (VRG-14) to 43.40 (Swarna Manjari) and cross combinations took 39.70 (Arka Prasan x VRG-16) to 43.00 (VRG-23 x VRG-16) (**Table 2**.). Similar results were reported by Abusaleha and Dutta (1994) and Shaha and Kale (2003).

For the character number of fruits per vine, parents took 15.30 (VRG-23) to 10.50 (VRG-14) and cross combinations took 18.70 (VRG-25 x Swarna Manjari) to 7.70 (VRG-11 x VRG-24) (**Table 2**.). These results are conformity with the findings of Abusaleha and Dutta (1994), Rao *et al*. (2000) and Shaha and Kale (2003). For fruit length, average fruit weight and fruit yield per vine, the parents took 30.10 (VRG-13) to 19.50 (VRG-23), 246.12 (VRG-11) to 111.70 (Arka Prasan) and 3.13 (VRG-11) to 1.66 (VRG-23 and VRG-24) respectively, and cross combinations took 38.10 (VRG-24 x VRG-13) to 15.30 (VRG-11 x VRG-15), 334.33 (VRG-24 x VRG-13) to 99.00 (VRG-25 x VRG-15) and 4.83 (VRG-24 x VRG-13) to 1.11 (VRG-25 x Swarna Manjari) (Table 2.). These results are conformity with the findings of Abusaleha and Dutta (1994) and Shaha and Kale (2003). For fruit diameter, fruit flesh thickness and the number of seeds per fruit, the parents took 15.20 (Arka Prasan) to 10.15 (VRG-24), 10.82 (Arka Prasan) to 3.12 (VRG-16) and 135.50 (VRG-14) to 78.97 (VRG-11) respectively, and cross combinations took 16.15 (VRG-23 x VRG-14) to 9.28 (VRG-23 x VRG-25), 14.18 (VRG-24 x VRG-14) to 15.30 (VRG-11 x VRG-24) and 216.11 (VRG-24 x VRG-13) to 79.90 (VRG-11 x VRG-23) (Table 2.). These results are conformity with the findings of Abusaleha and Dutta (1994) and Shaha and Kale (2003).

Among the ten parents studied VRG-25 and VRG-24 are identified as good general combiners as they made significant contribution towards growth and yield attributing traits. The cross combination, VRG-25 x Swarna Manjari recorded the highest number of fruits per vine. The cross combination, VRG-24 x VRG-13 for fruit length, average fruit weight and fruit yield per vine. These studies were prerequisite for breeding programmes.

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