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STUDY OF TRAIT RELATIONSHIPS IN F_2 POPULATION OF RIDGE GOURD (*LUFFA ACUTANGULA* L. ROXB.): A CORRELATION AND PATH ANALYSIS

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ABSTRACT

The research was conducted at the College of Horticulture, Bagalkot during *Rabi* 2024 in augmented design. To study correlation and path analysis in the F_2 generation of cross combination Arka Prasan and Sirsi Local. This study evaluated growth, earliness, yield and quality parameters to determine relationship among these traits. Correlation studies and Path analysis in segregating population revealed that total fruit yield per vine had significant positive correlation with vine length at harvest time (0.2460), number of primary branches per (0.3270), days to last harvest (0.5860), fruit length (0.3630), average fruit weight (0.6810) and number of fruits per vine (0.6190). Direct effect on fruit yield per vine was exhibited by traits like vine length at final harvest (0.0140), number of primary branches (0.0066), days to first female flower (0.0280), node at first female flower (0.0080), days to first harvest (0.0292), average fruit weight (0.7877) and number of fruits per vine (0.8645). Correlation studies in F_2 population revealed that total fruit yield per vine had significant positive correlation with number of fruits per vine, average fruit weight and fruit length. Average fruit weight and number of fruits per vine had high positive direct association with fruit yield per vine in F_2 population. Hence, direct selection of these traits would be more useful in the improvement of fruit yield per vine.
***Keywords*: ** Ridge gourd, Correlation, Path co-efficient analysis, Fruit yield per vine.

Introduction

Ridge gourd [*Luffa acutangula* (L.) Roxb.] is a warm-season vegetable cultivated extensively across India, with a long history in tropical regions of Asia and Africa (Sheshadri, 1980). It belongs to the genus *Luffa* within the Cucurbitaceae family, with diploid chromosome number of 2n = 26. Originating in India, ridge gourd is grown in tropical climate for its tender, edible fruits, both commercially and in home gardens and is favoured as a crop during the spring-summer and rainy seasons. This versatile vegetable is an excellent source of essential nutrients, including vitamin C, potassium and fibre, making it a valuable ingredient promoting digestive health and immune function. The seeds are known for their purgative, emetic and antihelmintic properties, attributed to the secondary metabolite cucurbitacin (Robinson and Decker-Walters, 1997). Ridge gourd is a climbing plant with a deep tap root system and simple, green, ovate leaves that typically have 5 to 7 lobes. While cultivated varieties are generally monoecious, several sex forms have been observed, including gynomonoecious, androecious, gynoecious andromonoecious and hermaphrodite (Choudhary and Thakur, 1965). The staminate flowers, featuring five fused stamens, grow in clusters of 10 to 20, while the pistillate flowers are solitary, varying in peduncle length and have a pleasant fragrance. Both types of flowers appear in the leaf axils. Flowering occurs between 5 and 7 PM and continues throughout the night, becoming ready for self-pollination during anthesis. The timing of flowering and anther dehiscence is influenced by temperature and humidity. The anthers are free and the pistil contains three placentas with multiple ovules. The stigmas are bilobate and three in number. The fruit is club-shaped, angular and has ten prominent ridges, containing numerous seeds. As it matures, the fruit hardens, becomes ridged and is no longer edible. The seeds are black, flattened and wrinkled, with a weight of about 150 to 170 grams per 1,000 seeds (Doijode, 2002).

Crop improvement efforts should prioritize selecting genotypes that enhance yield, quality and resistance to biotic stresses. Selection has long been a key element of vegetable crop enhancement and effective selection requires understanding the variation in traits that contribute to yield, as well as the environmental influence on these traits. It's important to ensure that the selected traits are inheritable, as much of the phenotypic variation can arise from environmental factors.

Biometrical methods in crop improvement helps to evaluate the phenotypic expression of traits in relation to their genetic value. Before improving yield, it's essential to analyse correlations and path coefficients among yield components, as relying solely on yield can be misleading due to its complexity. Correlation coefficients can show associations between traits but may not reveal the direct and indirect effects on yield. Path coefficient analysis, developed by Wright (1921), offers a more reliable method by distinguishing these effects. Given that little work has been done on the genetic improvement of ridge gourd, this study aims to explore correlation and path coefficient analysis for the species.

Material and Methods

The research was carried out at the University of Horticultural Sciences, Bagalkot, specifically at the College of Horticulture, Bagalkot, Karnataka, India, from January to May 2024. Hybrid Arka Prasan x Sirsi Local-2 were chosen to create the experimental material needed for the correlation and path analysis studies in the F_2 generation. Following selfing of this hybrid, F_2 seeds were obtained and used for the main experiment focusing on correlation and path studies. The experiment was carried out by using augmented design since each plant in the F_2 population was treated as a single genotype. Sowing took place on January 2024, at the Vegetable Science field of the College of Horticulture, Bagalkot. Seeds were pretreated with butter milk to enhance germination, then sown in trays filled with coco peat. Seedlings were transplanted to the main field 16 days after germination. Correlation and path analysis were conducted to evaluate growth, earliness, yield and quality parameters.

Observations were made on various parameters including growth metrics such as vine length at harvest time (m), the number of primary branches at 45 DAP, days to first male flowering, days to first female flowering, the node of first female flowering, the node of first male flowering, sex ratio (male to female), days to first harvest and days to last harvest. Yield parameters includes the number of fruits per vine, fruit length (cm), fruit weight (g), fruit diameter (mm), fruit yield per vine (kg), number of seeds per fruit. Quality parameter measured was fruit tenderness. The observations are detailed in the below tables.

Results and Discussion

Increased yield can be achieved by using indirect selection based on morphological traits. This requires a thorough understanding of how these traits are related, as this helps in enhancing yield by improving various associated characteristics. To explore this, correlation studies are conducted to evaluate the potential for improving yield through indirect selection of yield-related attributes. The correlation coefficients between yield and its attributes were measured in two F_2 population are discussed below

The fruit yield per vine showed positive and significant association with vine length at harvest time (0.2460), number of primary branches per vine (0.3270), days to last harvest (0.5860), fruit length (0.3630), average fruit weight (0.6810), number of fruits per vine (0.6190), number of seeds per fruit (0.4930), while the correlation with fruit diameter (0.1350) and fruit tenderness (0.0510) was positive but not significant. Since, these association characters are in the desirable direction, selection for these traits may improve the yield per vine. Conversely, Fruit yield per vine had significant negative correlations with days to first male flower (-0.1970), days to first female flower (-0.1930), node at first male flower (-0.2000), node at first female flower (-0.1990), days to first harvest (-0.4160) and sex ratio (-0.2900). Implies that as days to first female and male flowering increases and fruit yield per pant decreases. Matching conclusions were confirmed by Gowda *et al*. (2011), Rabbani *et al.* (2012), Chowdary *et al.* (2014), Narasannanavar *et al.* (2014), Koppad *et al.* (2015), Khatoon *et al.* (2016), Manoj *et al.*(2018), Bhusnar (2019), Kannan, and Rajamanickam (2019), Akhila and Singh (2020) and Vijayakumar *et al.* (2020) in ridge gourd as presented in Table 1.

Table 1 : Phenotypic correlation coefficients for various traits in F_2 generation of Arka Prasan x Sirsi Local

Traits	VL	PBPT	DFF	DFM	NMF	NFF	DFHT	DLHT	SR	FL	FD	AVGWT	NFPT	NSF	FT	FYV
VL	**1.0000**	0.2960**	-0.0640	-0.0200	-0.0150	-0.0160	-0.1330	0.1640*	-0.1810*	0.1120	-0.0080	0.1130	0.1940**	0.0690	0.0340	0.2460**
PBPT		**1.0000**	-0.1040	-0.1060	-0.0610	0.0420	-0.2330**	0.3040**	-0.2250**	0.1020	0.1370	0.2020**	0.2210**	0.1570*	0.0800	0.3270**
DFF			**1.0000**	0.9430**	0.0300	0.0360	0.2720**	0.1910**	0.0780	-0.0240	-0.0100	-0.0550	-0.2010**	-0.0180	0.0030	-0.1930**
DFM				**1.0000**	0.0460	0.0200	0.2940**	-0.1590*	0.0620	0.0140	-0.0250	-0.0680	-0.1900**	-0.0720	0.0160	-0.1970**
NMF					**1.0000**	0.9000**	0.1010	-0.1200	0.1760*	-0.0500	-0.0660	-0.1630*	-0.1110	-0.1060	-0.2100**	-0.2000**
NFF						**1.0000**	0.1040	-0.0800	0.1770*	-0.0630	-0.0870	-0.1880**	-0.0850	-0.1210	-0.1730*	-0.1990**
DFHT							**1.0000**	-0.3850**	0.2220**	-0.1890**	-0.0520	-0.2370**	-0.3410**	-0.2480**	-0.0880	-0.4160**
DLHT								**1.0000**	0.2030**	0.2400**	0.0470	0.4290**	0.3490**	0.2500**	0.0140	0.5860**
SR									**1.0000**	-0.2800**	-0.1710*	-0.1930**	-0.1630*	-0.1470*	-0.1000	-0.2900**
FL										**1.0000**	0.0650	0.2770**	0.1890**	0.1970**	-0.0690	0.3630**
FD											**1.0000**	0.1990**	-0.0120	0.0770	0.1550*	0.1350
AVGWT												**1.0000**	-0.1390	0.3730**	-0.0170	0.6810**
NFPT													**1.0000**	0.2820	0.0950	0.6190**
NSF														**1.0000**	0.0070	0.4930**
FT															**1.0000**	0.0510
FYV																**1.0000**

* and ** indicates significance at $P \leq 0.05$ and $P \leq 0.01$ respectively

VL- Vine length at final harvest (m)
PBPT- Number of primary branches (45DAT)
DFF- Days to first female flower
DFM- Days to first male flower
NFM- Node at first male flower
NFF- Node at first female flower
DFHT- Days to first harvest
DLHT- Days to last harvest
SR- Sex ratio (M: F)
FL- Fruit length (cm)
FD- Fruit diameter (mm)
AVGWT- Average fruit weight (g)
NFPT- Number of fruits per vine
FT- Fruit tenderness (N)
FYV- Fruit yield per vine (kg)

Table 2 : Phenotypic path coefficients of various traits in F_2 generation of Arka Prasan x Sirsi Local

Traits	VL	PBPT	DFF	DFM	NMF	NFF	DFHT	DLHT	SR	FL	FD	AVGWT	NFPT	NSF	FT	rP
VL	**0.0140**	0.0020	-0.0018	0.0008	0.0000	-0.0001	-0.0039	-0.0010	0.0047	0.0009	0.0001	0.0887	0.1419	-0.0004	0.0000	0.2459**
PBPT	0.0042	**0.0066**	-0.0029	0.0041	-0.0002	-0.0003	-0.0068	-0.0018	0.0058	0.0008	-0.0023	0.1594	0.1616	-0.0008	-0.0001	0.3273**
DFF	-0.0009	-0.0007	**0.0280**	-0.0363	0.0001	-0.0003	0.0080	0.0011	-0.0020	-0.0002	0.0002	-0.0433	-0.1469	0.0001	0.0000	-0.1932**
DFM	-0.0003	-0.0007	0.0264	**-0.0385**	0.0001	-0.0002	0.0086	0.0009	-0.0016	0.0001	0.0004	-0.0539	-0.1390	0.0004	0.0000	-0.1972**
NMF	-0.0002	-0.0004	0.0009	-0.0018	**0.0025**	0.0072	0.0030	0.0007	-0.0046	-0.0004	0.0011	-0.1281	-0.0810	0.0006	0.0002	-0.2004**
NFF	-0.0002	-0.0003	-0.0010	0.0008	0.0023	**0.0080**	0.0031	0.0005	-0.0046	-0.0005	0.0015	-0.1477	-0.0619	0.0006	0.0002	-0.1994**
DFHT	-0.0019	-0.0015	0.0076	-0.0113	0.0003	0.0008	**0.0292**	0.0022	-0.0058	-0.0016	0.0009	-0.1869	-0.2491	0.0013	0.0001	-0.4157**
DLHT	0.0023	0.0020	-0.0053	0.0061	-0.0003	-0.0006	-0.0112	**-0.0058**	0.0053	0.0020	-0.0008	0.3383	0.2553	-0.0013	0.0000	0.5858**
SR	-0.0026	-0.0015	0.0022	-0.0024	0.0005	0.0014	0.0065	0.0012	**-0.0259**	-0.0023	0.0029	-0.1517	-0.1191	0.0008	0.0001	-0.2899**
FL	0.0016	0.0007	-0.0007	-0.0006	-0.0001	-0.0005	-0.0055	-0.0014	0.0073	**0.0082**	-0.0011	0.2179	0.1380	-0.0010	0.0001	0.3628**
FD	-0.0001	0.0009	-0.0003	0.0010	-0.0002	-0.0007	-0.0015	-0.0003	0.0044	0.0005	**-0.0170**	0.1569	-0.0086	-0.0004	-0.0002	0.1346
AVGWT	0.0016	0.0013	-0.0015	0.0026	-0.0004	-0.0015	-0.0069	-0.0025	0.0050	0.0023	-0.0034	**0.7877**	-0.1013	-0.0020	0.0000	0.6810**
NFPT	0.0027	0.0015	-0.0056	0.0073	-0.0003	-0.0007	-0.0099	-0.0020	0.0042	0.0016	0.0002	-0.1091	**0.7312**	-0.0015	-0.0001	0.6195**
NSF	0.0010	0.0010	-0.0005	0.0028	-0.0003	-0.0010	-0.0073	-0.0015	0.0038	0.0016	-0.0013	0.2935	0.2066	**-0.0052**	0.0000	0.4933**
FT	0.0005	0.0005	0.0001	-0.0006	-0.0005	-0.0014	-0.0026	-0.0001	0.0026	-0.0006	-0.0026	-0.0132	0.0698	0.0000	**-0.0010**	0.0510

Residual effect = **0.01481**   Diagonal values indicate direct effect   rP: Phenotypic correlation coefficient of fruit yield per vine

VL- Vine length at final harvest (m)
PBPT- Number of primary branches (45DAT)
DFF- Days to first female flower
DFM- Days to first male flower
NFM- Node at first male flower
NFF- Node at first female flower
DFHT- Days to first harvest
DLHT- Days to last harvest
SR- Sex ratio (M: F)
FL- Fruit length (cm)
FD- Fruit diameter (mm)
AVGWT- Average fruit weight (g)
NFPT- Number of fruits per vine
FT- Fruit tenderness (N)

Correlation study shows the relationship between the independent and dependent variables without establishing a specific cause and effect link. By using path coefficient analysis can break down correlation into the direct and indirect contributions of various quantitative trait. The path coefficients indicating the nature and magnitude of direct and indirect effects of different characters towards fruit yield per vine were analysed at phenotypic level. Essentially, it is a form of standardized partial regression analysis that breaks down overall correlation values into the contributions of individual causal factors.

In the present investigation path coefficient analysis in F_2 population revealed positive direct effect on fruit yield per vine with the traits, like vine length at final harvest (0.0140), number of primary branches (0.0066), days to first female flower (0.0280), node at first male flower appear (0.0025), node at first female flower appear (0.0080), days to first harvest (0.0292), fruit length (0.0082), average fruit weight (0.7877) and number of fruits per vine (0.7312) showed positive direct effects. These effects were influencing directly in increasing the yield of the crop, selecting the traits which directly influence the yield will be more desirable for the crop improvement. But six characters *viz.,* days to first male flower (-0.0385), days taken to last harvest (-0.0058), sex ratio (-0.0259), fruit diameter (-0.0170), number of seeds per fruit (-0.0052) and fruit tenderness (-0.0010) were shown negligible negative, direct effect on total yield. These results are in line with the findings of Khule *et al.* (2011), Narasannanavar *et al.* (2014), Kanimozhi *et al*. (2015), Varalakshmi *et al*. (2015), Ananthan and Krishnamoorthy (2017), Pooja (2018), Ramesh *et al.* (2018), Kannan *et al.* (2019), Harshitha *et al.* (2019), Krishnamoorthy (2020) and Vijayakumar *et al.* (2020) as presented in Table 2.

Conclusion

Correlation studies and Path analysis in segregating population revealed that total fruit yield per vine had significant positive correlation with vine length at harvest time, number of primary branches per vine, days to last harvest, average fruit weight and number of fruits per vine. As there is increase in number of fruits per vine, average fruit weight certainly there will be increase in fruit yield, this can said to be one of the desirable characters for the improvement. Since, these association characters are in the desirable direction, selection for these traits may improve the yield per vine. Direct effect on fruit yield per vine with the traits, like vine length at final harvest, number of primary branches, days to first female flower, node at first female flower, days to first harvest, average fruit weight and number of fruits per vine. These effects were influencing directly increasing the yield of the crop. Hence, focusing on direct selection for these characteristics would be highly advantageous in enhancing yield.

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