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CORRELATION AND PATH ANALYSIS OF YIELD-ATTRIBUTING TRAITS IN F_2 POPULATION OF RIDGE GOURD (*LUFFA ACUTANGULA* L. ROXB)

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ABSTRACT

A field investigation was carried out during the late *kharif* season of 2024 at the experimental block of the Department of Vegetable Science, College of Horticulture, Bagalkot, to assess correlation and path analysis in two F_2 populations derived from the crosses KLR-2 × Arka Prasan (cross-I) and RGE-2 × Arka Prasan (cross-II), using an augmented design. The results revealed that both crosses showed a significant positive correlation between fruit yield per vine and traits such as vine length at the last harvest, number of primary branches at final harvest, fruit length, fruit diameter, average fruit weight and number of fruits per vine. As these traits showed a desirable association, simultaneous selection for them may contribute to increased yield per vine. Path co-efficient analysis revealed that maximum direct contribution towards yield per vine with average fruit weight (g) and number of fruits per vine. Hence, direct selection, number of fruits per vine and average fruit weight (g) may be reliable for yield improvement.

Keywords : Correlation, path analysis, Ridge gourd.

Introduction

Ridge gourd (*Luffa acutangula* (L.) Roxb.) is an important vegetable crop belonging to the family Cucurbitaceae, with a chromosome number of 2n = 26. Cucurbitaceous vegetables constitute a major group in global vegetable production. Among the cucurbits, ridge gourd is one of the most preferred vegetables in India. It is a major vegetable crop of several Asian countries, particularly India and China, as it is believed to have originated in the Tropical Asia region and is widely cultivated there and in other parts of Southeast Asia. Other Asian countries with ridge gourd cultivation and consumption include the Philippines, Myanmar, Thailand, Bangladesh and Nepal. It is a rich source of iron, vitamin C, manganese and dietary fibre. As the tender fruits are easily digestible and appetizing, they are often recommended for individuals suffering from malaria and other seasonal fevers. Genus name was derived from the product "Loofah" used as bathing sponges, scrubber pads, doormats, pillows, mattresses, cleaning utensils (Swamy, 2023). Historically, ridge gourd has been used as an emetic in the treatment of stomach ailments and fevers (Chakravarthy, 1959). Its seeds contain cucurbitacin, a secondary metabolite known for its purgative, emetic and anti-helminthic properties (Robinson and Decker-Walters, 1997). Furthermore, research on the isolation of ribosome-inactivating proteins (RIPs) and luffaculin from ridge gourd seeds has garnered interest due to their promising medicinal potential including abortifacient, anti-fungal, anti-tumor, anti-viral and HIV-1 integrase inhibitory activities (Hou *et al*., 2006).

Material and Methods

The study was conducted at the College of Horticulture, Bagalkot, during the late *kharif* season of 2024. The crosses *viz.*, KLR-2 × Arka Prasan and RGE-2 × Arka Prasan, were evaluated using an augmented design with a spacing of 2 × 1 m. The evaluated material consisted of two F_2 populations, each comprising 252 plants grown across seven blocks, including three check entries (parents and F_1 hybrids). Observations were recorded for the following traits are days to first male flowering, days to first female flowering, node at first male flower, node at first female flower, vine length at final harvest, number of primary branches at last harvest, days to first harvest, days to last harvest, number of fruits per vine, average fruit weight (g), fruit length (cm), fruit diameter (mm) and fruit yield per vine (kg).

Results and Discussion

In ridge gourd 13 parameters were subjected to phenotypic correlation coefficient analysis are presented in Table 1 and Table 2 of cross -I and cross-II respectively.

Correlation coefficient analysis

Understanding the magnitude and direction of the relationship between yield and its contributing traits is crucial for enhancing yield in ridge gourd. In the F_2 generation of both crosses- KLR-2 × Arka Prasan and RGE-2 × Arka Prasan correlation coefficients between fruit yield and thirteen associated traits were estimated and are presented in Tables 1 and 2.

In the cross KLR-2 × Arka Prasan, fruit yield per vine exhibited significant and positive correlations with vine length at final harvest (0.565), number of primary branches at last harvest (0.731), fruit length (0.398), fruit diameter (0.036), average fruit weight (0.928) and number of fruits per vine (0.323). Similarly, in the RGE-2 × Arka Prasan cross, fruit yield showed significant positive associations with vine length at final harvest (0.599), days to last harvest (0.186), number of primary branches (0.355), fruit length (0.215), fruit diameter (0.148), average fruit weight (0.924) and number of fruits per vine (0.560). These findings suggest that selecting for these yield-contributing traits could effectively enhance fruit yield in ridge gourd. Comparable results were also reported by Akhila and Singh (2020), Ananthan and Krishnamoorthy (2017), Hanumegowda *et al*. (2018) and Narasannavar *et al*. (2014) in ridge gourd.

Inter correlations among yield attributing components

In both crosses, days to first male flowering showed a strong and significant positive correlation with days to first female flowering and days to first harvest, supporting the findings of Choudhary *et al.* (2014) and Kannan *et al*. (2019), who emphasized that early-flowering genotypes tend to produce higher yields, making earliness a valuable trait for selection. Average fruit weight was highly and positively correlated with the number of primary branches at last harvest, vine length at final harvest and fruit length in both populations, in line with observations by Koppad *et al*. (2016) and Wani *et al*. (2008) in ridge gourd. In Cross-I, fruit length showed significant associations with average fruit weight, number of primary branches and vine length at final harvest, while in Cross-II, it was significantly correlated with vine length at final harvest, average fruit weight, fruit diameter and number of fruits per vine, consistent with the reports of Manoj *et al*. (2018) and Kannan *et al*. (2019). The number of primary branches exhibited strong positive correlations with average fruit weight, fruit length, number of fruits per vine and vine length in Cross-I, and with vine length at last harvest, days to last harvest and average fruit weight in Cross-II, which agrees with the findings of Vijaykumar *et al*. (2020). Additionally, the number of fruits per vine showed significant positive correlations with the number of primary branches and vine length at final harvest in both populations, as also reported by Mitu *et al*. (2018) and Rabbani *et al*. (2012). These results suggest that selecting for traits such as higher fruit number, larger fruit size and greater fruit weight can lead to improved total yield, as vines bearing more and larger fruits are typically more productive.

Path coefficient analysis

The results of path coefficient analysis for the present experiment are presented in Table 3 and Table 4 for Cross-I and Cross-II, respectively

Path coefficient analysis of F_2 cross -I indicated that traits such as vine length at last harvest (0.0404), days to first female flower (0.0194), node at first male flower (0.0102), days to first harvest (0.0101), average fruit weight (0.9173), number of fruits per vine (0.3414) and days to last harvest (0.0074) exhibited positive direct effects on fruit yield per vine. These traits contributed directly to yield enhancement, suggesting that selection for characters with strong direct influence on yield would be advantageous for crop improvement. In contrast, days to first male flower (-0.0547), node at first female flower (-0.0206), fruit length (-0.0008), fruit diameter (-0.0161) and number of primary branches at last harvest (-0.0042) showed minimal negative direct effects on total fruit yield per vine similar results reported by Vijaykumar *et al*. (2020) and Khatoon *et al*. (2016).

In cross -II, among the twelve traits studied, seven exhibited a positive direct effect on fruit yield per vine. These include days to first male flower (0.0108), node at first male flower (0.0080), vine length at last harvest

(0.0208), number of primary branches at last harvest (0.0105), fruit diameter (0.0023), average fruit weight (0.8279) and number of fruits per vine (0.3791). In contrast, five traits namely days to first female flower (-0.0006), fruit length (-0.0044), node at first female flower (-0.0066) days to first harvest (-0.0032) and days to last harvest (-0.0066) demonstrated slight negative direct effects on total yield. Similar observations reported by Karuppiah *et al.* (2005) in ridge gourd and Kumari *et al.* (2018) in bitter gourd.

Conclusion

Fruit yield per vine exhibited a positive and significant correlation with vine length at final harvest, number of primary branches at the last harvest, fruit length, fruit diameter, average fruit weight and number of fruits per vine. Therefore, these attributes hold substantial importance and can be effectively utilized as key indicators in breeding programs directed towards yield improvement. Path coefficient analysis revealed that several traits exerted positive direct effects on fruit yield per vine. These attributes contributed directly to yield improvement, indicating that selecting for characters with strong direct influence on yield would be highly beneficial in crop improvement programs.

Table 1: Correlation analysis of yield and related traits in F_2 population of cross -I

Traits	DMF	DFF	N@FMF	N@FFF	D@FH	D@LH	VL@LH	NPB@FH	FL	FD	AFW	NF/V	FY/V
DMF	**1.000**	0.697*	0.253*	-0.041	0.657*	0.131*	-0.011	-0.05	-0.147*	-0.051	-0.003	-0.059	-0.038
DFF		**1.000**	0.216*	0.139*	0.916*	0.191**	-0.059	-0.051	-0.12	-0.051	-0.006	-0.055	-0.031
N@FMF			**1.000**	0.337*	0.209*	0.054	0.063	-0.028	0.004	-0.039	0.025	-0.121	-0.024
N@FFF				**1.000**	0.101	-0.103	0.015	-0.086	0.015	-0.096	-0.029	0.019	-0.028
D@FH					**1.000**	0.233*	-0.007	0.032	-0.082	-0.035	0.045	0.024	0.031
D@LH						**1.000**	0.028	0.062	-0.011	0.039	0.013	-0.001	0.024
VL@LH							**1.000**	0.571**	0.267**	-0.01	0.511**	0.165*	0.565**
NPB@FH								**1.000**	0.411*	0.005	0.677**	0.227*	0.731**
FL									**1.000**	0.043	0.406*	0.034	0.398**
FD										**1.000**	0.036	0.054	0.036*
AFW											**1.000**	-0.03	0.928**
NF/V												**1.000**	0.323**
FY/V													**1.000**

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

DMF-Days to first male flower
DFF-Days to first female flower
N@FMF-Node at first male flower
N@FFF-Node at first female flower
D@FH-Days to first harvest
FL-Fruit length
FD-Fruit diameter
AFW-Average fruit weight
FY/V-Fruit yield per vine
NF/V-Number of fruits per vine
NPB@LH -No. primary branches at last harvest
V@LH-Vine length at Last harvest
D@LH-Days to last harvest

Table 2: Correlation analysis of yield and related traits in F_2 population of cross -II

Traits	DMF	DFF	N@FMF	N@FFF	D@FH	D@LH	VL@LH	NPB@FH	FL	FD	AFW	NF/V	FY/V
DMF	**1.000**	0.701*	-0.055	0.01	0.572*	-0.095	-0.057	-0.032	-0.019	0.012	-0.006	-0.046	-0.025
DFF		**1.000**	-0.024	0.09	0.822*	-0.024	-0.037	0.057	0.031	0.034	-0.035	-0.082	-0.06
N@FMF			**1.000**	0.424*	-0.051	0.087	0.038	0.023	0.082	-0.001	-0.006	-0.065	-0.031
N@FFF				**1.000**	0.017	0.075	0.035	0.046	0.088	0.137*	-0.031	0.019	-0.022
D@FH					**1.000**	-0.005	0.073	0.101	0.034	0.065	0.117	-0.005	0.102
D@LH						**1.000**	0.33*	0.445*	0.008	0.022	0.217**	0.005	0.186*
VL@LH							**1.000**	0.588*	0.228**	0.134*	0.54**	0.319**	0.599*
NPB@FH								**1.000**	0.111	0.063	0.33*	0.185*	0.355**
FL									**1.000**	0.377*	0.19**	0.16*	0.215**
FD										**1.000**	0.1	0.171**	0.148*
AFW											**1.000**	0.213*	0.924**
NF/V												**1.000**	0.56**
FY/V													**1.000**

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

DMF-Days to first male flower
DFF-Days to first female flower
N@FMF-Node at first male flower
N@FFF-Node at first female flower
D@FH-Days to first harvest
FL-Fruit length
FD-Fruit diameter
AFW-Average fruit weight
FY/V-Fruit yield per vine
NF/V-Number of fruits per vine
NPB@LH -No. primary branches at last harvest
V@LH-Vine length at Last harvest
D@LH-Days to last harvest

Table 3 : Phenotypic path coefficients of various traits in F_2 generation of cross-I

Traits	DMF	DFF	N@FMF	N@FFF	D@FH	D@LH	VL@LH	NPB@FH	FL	FD	AFW	NF/V	rG
DMF	**-0.0547**	0.0136	0.0026	0.0008	0.0067	0.0010	-0.0006	0.0002	0.0003	0.0008	0.0020	-0.0105	-0.0380
DFF	-0.0313	**0.0194**	0.0023	-0.0039	0.0093	0.0014	-0.0030	0.0002	0.0010	0.0008	-0.0092	-0.0171	-0.0310
N@FMF	-0.0112	0.0043	**0.0102**	-0.0090	0.0021	0.0004	0.0040	0.0001	0.0010	0.0006	0.0183	-0.0410	-0.0240
N@FFF	0.0018	0.0027	0.0035	**-0.0206**	0.0010	-0.0007	0.0010	0.0004	0.0010	0.0016	-0.0275	0.0068	-0.0280
D@FH	-0.0295	0.0178	0.0021	-0.0021	**0.0101**	0.0017	-0.0005	-0.0001	0.0006	0.0005	0.0367	-0.0068	0.0310
D@LH	-0.0058	0.0037	0.0005	0.0021	0.0023	**0.0074**	0.0015	-0.0003	0.0010	-0.0006	0.0092	0.0010	0.0240
VL@LH	0.0004	-0.0012	0.0006	-0.0004	-0.0001	0.0002	**0.0404**	-0.0024	-0.0002	0.0002	0.4678	0.0546	0.565**
NPB@FH	0.0022	-0.0010	-0.0003	0.0018	0.0003	0.0004	0.0287	**-0.0042**	-0.0003	0.0010	0.6238	0.0785	0.731**
FL	0.0067	-0.0023	-0.0100	-0.0002	-0.0008	-0.0007	0.0136	-0.0017	**-0.0008**	-0.0006	0.3761	0.0102	0.398**
FD	0.0022	-0.0010	-0.0004	0.0021	-0.0003	0.0003	-0.0005	-0.0030	0.0010	**-0.0161**	0.0367	0.0171	0.036*
AFW	-0.0010	-0.0002	0.0002	0.0006	0.0004	0.0007	0.0257	-0.0029	-0.0003	-0.0006	**0.9173**	-0.0102	0.928**
NF/V	0.0027	-0.0010	-0.0012	-0.0004	-0.0002	0.0010	0.0081	-0.0010	-0.0002	-0.0008	-0.0275	**0.3414**	0.323**

Residual effect = 0.010938
Diagonal values indicate direct effect
rG: Genotypic correlation coefficient of fruit yield per vine

DMF-Days to first male flower
DFF-Days to first female flower
N@FMF-Node at first male flower
N@FFF-Node at first female flower
D@FH-Days to first harvest
FL-Fruit length
FD-Fruit diameter
AFW-Average fruit weight
D@LH-Days to last harvest
NF/V-Number of fruits per vine
V@LH-Vine length at last harvest
NPB@LH-No. Primary branches at last harvest

Table 4: Phenotypic path coefficients of various traits in F_2 generation of cross -II

Traits	DMF	DFF	N@FMF	N@FFF	D@FH	D@LH	VL@LH	NPB@FH	FL	FD	AFW	NF/V	rG
DMF	**0.0108**	-0.0004	-0.0005	-0.0007	-0.0018	0.0007	-0.0012	-0.0003	0.0009	0.0002	-0.0083	-0.0190	-0.025
DFF	0.0076	**-0.0006**	-0.0002	-0.0006	-0.0026	0.0001	-0.0008	0.0006	-0.0001	0.0007	-0.0331	-0.0303	-0.06
N@FMF	-0.0006	0.0001	**0.0080**	-0.0028	0.0002	-0.0006	0.0008	0.0002	-0.0004	0.0001	-0.0083	-0.0265	-0.031
N@FFF	0.0001	-0.0006	0.0034	**-0.0066**	-0.0006	-0.0005	0.0006	0.0005	-0.0004	0.0003	-0.0248	0.0076	-0.022
D@FH	0.0062	-0.0005	-0.0004	-0.0001	**-0.0032**	0.0001	0.0015	0.0010	-0.0001	0.0001	0.0993	-0.0038	0.102
D@LH	-0.0011	0.0001	0.0007	-0.0005	0.0010	**-0.0066**	0.0069	0.0047	-0.0004	0.0005	0.1821	0.0038	0.186*
VL@LH	-0.0006	0.0002	0.0003	-0.0002	-0.0002	-0.0022	**0.0208**	0.0062	-0.0010	0.0003	0.4554	0.1213	0.599*
NPB@FH	-0.0003	-0.0004	0.0002	-0.0003	-0.0003	-0.0030	0.0123	**0.0105**	-0.0005	0.0001	0.2732	0.0682	0.355*
FL	-0.0002	-0.0002	0.0006	-0.0006	-0.0010	-0.0007	0.0048	0.0012	**-0.0044**	0.0009	0.1573	0.0607	0.215**
FD	0.0001	-0.0002	0.0001	-0.0009	-0.0002	-0.0001	0.0027	0.0006	-0.0017	**0.0023**	0.0828	0.0645	0.148*
AFW	-0.0001	0.0002	-0.0008	0.0002	-0.0004	-0.0015	0.0114	0.0035	-0.0008	0.0002	**0.8279**	0.0796	0.924**
NF/V	-0.0005	0.0005	-0.0006	-0.0001	0.0003	-0.0007	0.0066	0.0019	-0.0007	0.0004	0.1739	**0.3791**	0.56**

Residual effect = 0.012259
Diagonal values indicate direct effect
rG: Genotypic correlation coefficient of fruit yield per vine

DMF-Days to first male flower
DFF-Days to first female flower
N@FMF-Node at first male flower
N@FFF-Node at first female flower
D@FH-Days to first harvest
FL-Fruit length
FD-Fruit diameter
AFW-Average fruit weight
D@LH-Days to last harvest
NF/V-Number of fruits per vine
V@LH-Vine length at last harvest
NPB@LH-No. Primary branches at last harvest

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