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CORRELATION AND PATH COEFFICIENT ANALYSIS FOR FRUIT YIELD AND ITS COMPONENT TRAITS IN RIDGE GOURD (*Luffa acutangula* L.) GENOTYPES

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ABSTRACT

Fruit yield in ridge gourd (*Luffa acutangula* L.) is a complex quantitative trait governed by the interaction of several growths, flowering and fruit-related characters. Therefore, identification of traits having strong association with yield and determination of their direct and indirect contributions are essential for developing effective selection strategies. The present investigation was conducted using 30 ridge gourd genotypes evaluated during *Rabi* 2025–2026 at the Vegetable Research Block, College of Horticulture, Dr. Y.S.R. Horticultural University, Anantharajupeta. Genotypic and phenotypic correlation coefficients were estimated for yield and its component traits, followed by path coefficient analysis to study the direct and indirect effects of different characters on fruit yield per vine. At the genotypic level, average fruit weight showed the highest positive and significant correlation with fruit yield per vine (r = 0.953), followed by number of fruits per harvest (0.667), number of fruits per vine (0.648), vine length (0.526), number of nodes per vine (0.502). At the phenotypic level, average fruit weight also showed the highest positive and significant correlation with fruit yield per vine (r = 0.952), followed by number of fruits per vine (0.647), number of fruits per harvest (0.605), vine length (0.524) and number of nodes per vine (0.499). In path coefficient analysis, average fruit weight recorded the highest positive direct effect (0.755), followed by number of fruits per vine (0.196), number of seeds per fruit (0.152), hundred seed weight (0.073), number of nodes per vine (0.057), and sex ratio (0.016). Negative direct effects were recorded for fruit set (-0.213), number of fruits per harvest (-0.206), number of primary branches per vine (-0.135), internodal length (-0.072), , firmness (-0.057) and vine length (-0.042). Although fruit set and number of fruits per harvest had negative direct effects, their correlations with yield were positive. This was mainly because of their positive indirect effects through other yield-related traits, particularly average fruit weight, number of fruits per vine and fruit length.

***Key words*:** Ridge gourd, genotypic correlation, phenotypic correlation, path coefficient analysis, fruit yield, yield components.

Introduction

Ridge gourd (*Luffa acutangula* (L.) Roxb.] is an important cucurbitaceous vegetable crop widely grown in tropical and subtropical regions. Considerable variation is found among ridge gourd genotypes for vegetative growth, flowering behaviour, fruit characteristics and yield, which provides useful scope for selecting superior genotypes for crop improvement. Fruit yield is a complex trait influenced by several component characters and their interactions. Therefore, selecting genotypes based on yield alone may not always be sufficient for achieving effective improvement in productivity. Correlation analysis is useful for assessing the magnitude and direction of association between fruit yield and its component traits. However, correlation coefficients alone cannot determine whether the association results from the direct effect of a particular trait or from its association with other traits. Path coefficient analysis provides further insight by partitioning the correlation coefficients into direct and indirect effects. Thus, it helps to assess the relative contribution of

individual characters to fruit yield and to identify traits that can be considered important for selection in ridge gourd breeding.

More recent studies have reinforced this trend across different genetic materials and environments. Harshitha *et al.*, (2019) observed significant positive associations of fruit yield with primary branches, vine length, number of nodes, percentage fruit set, number of fruits per plant, fruit weight and fruit length in 25 ridge gourd genotypes. In early-generation populations derived from commercial hybrids, Madhuri *et al.*, (2022) reported significant positive associations of fruit yield with vine length, number of fruits per vine, average fruit weight, fruit length and fruit diameter, whereas days to first male and female flowering and sex ratio showed negative associations with yield.

Therefore, the present investigation was undertaken to determine the association of morphological, flowering and fruit characters with fruit yield and to identify the traits exerting the greatest direct and indirect influence on yield in the evaluated ridge gourd genotypes.

Material and Methods

The present investigation was carried out using 30 ridge gourd genotypes during *Rabi* 2025-2026 at the Vegetable Research Block, College of Horticulture, Dr. Y.S.R. Horticultural University, Anantharajupeta. The study was part of a broader evaluation of the genotypes for genetic variability, trait association, path analysis and genetic divergence. Significant differences were observed among the genotypes for the characters studied, indicating adequate variability in the experimental material.

For correlation and path analysis, fruit yield per vine was taken as the dependent character. The characters considered as independent variables were vine length, internodal length, number of nodes per vine, sex ratio, average fruit weight, fruit set, number of seeds per fruit, hundred-seed weight, number of fruits per vine, number of fruits per harvest and fruit firmness.

Genotypic and phenotypic correlation coefficients were calculated to assess the strength and direction of association between fruit yield and its component characters. Path coefficient analysis was then carried out to determine the direct and indirect effects of the component traits on fruit yield.

Results and Discussion

The prevailing relationships between characters are generally governed by phenotypic and genotypic correlations. Phenotypic correlation is defined as the correlation between two variables, which includes both the genotypic and environmental effects. Genotypic correlation on the other hand is the intrinsic association between two variables and it may be due to the linkage or pleotropic action of genes or both. In the present study character association between yield and 17 yield attributing traits disclosed that genotypic correlation were higher in magnitude compared to phenotypic correlation suggesting a strong inherent relationship between genotypes and also narrow differences were observed between phenotypic and genotypic correlations indicates that environmental effect was little and results were presented in Table 1.

Fruit yield per vine showed positive and significant correlation at both genotypic and phenotypic levels with average fruit weight (0.953G, 0.952P), number of fruits per vine (0.648G, 0.647P), number of fruits per harvest (0.667G, 0.605P), vine length (0.526G, 0.524P) and number of nodes per vine (0.502G, 0.499P), indicating that these traits were important yield-contributing characters and selection based on these traits may result in improvement of fruit yield in ridge gourd. Among them, average fruit weight recorded the strongest association with fruit yield, followed by number of fruits per harvest and number of fruits per vine. The positive association of average fruit weight with number of fruits per vine (0.608G, 0.607P), number of fruits per harvest (0.656G, 0.597P), vine length (0.523G, 0.521P) and number of nodes per vine (0.501G, 0.498P) indicates that genotypes producing heavier fruits were generally associated with better fruit-bearing ability. Number of fruits per vine also showed a strong positive association with number of fruits per harvest (0.994G, 0.909P), while both traits were positively associated with fruit size and vegetative growth characters, suggesting that higher fruit number together with greater fruit weight contributed to increased total yield.

Among the vegetative characters, vine length and number of nodes per vine showed significant positive associations with fruit yield (0.526G, 0.524P and 0.502G, 0.499P, respectively). Vine length was strongly associated with number of nodes per vine (0.995G, 0.985P), average fruit weight (0.523G, 0.521P), number of fruits per vine (0.468G, 0.468P) and number of fruits per harvest (0.465G, 0.431P), while number of nodes per vine showed positive relationships with average fruit weight (0.501G, 0.498P), number of fruits per vine (0.448G, 0.444P) and number of fruits per harvest (0.439G, 0.381P). Internodal length showed a positive but relatively weak association with fruit yield (0.326G, 0.325P). These results indicate that better vegetative growth, particularly greater vine length and node number, provided a favourable basis for fruit production.

Sex ratio showed a positive but non-significant

Table 1: Genotypic Correlation and Phenotypic correlation among 30 Ridge gourd genotypes.

		VL	IL	NNV	SR	AFW	FS	NSF	HSW	NFV	NFH	FRM	FYPV
		Phenotypic Correlation											
VL	**Genotypic Correlation**	1	0.342**	0.985**	0.259*	0.521**	0.039	0.503**	-0.055	0.468**	0.431**	-0.033	0.524**
IL		0.343	1	0.376**	-0.022	0.400**	0.005	0.273*	0.257*	0.132	0.126	0.068	0.325*
NNV		0.995 **	0.380 *	1	0.236	0.498**	0.009	0.512**	-0.055	0.444 **	0.381 **	0.006	0.499**
SR		0.260	-0.022	0.241	1	0.276 *	-0.738**	-0.014	0.031	0.347 **	0.372 **	-0.328 *	0.249
AFW		0.523 **	0.401 *	0.501 **	0.276	1	0.024	0.076	0.138	0.607 **	0.597 **	-0.188	0.952**
FS		0.039	0.005	0.010	-0.743**	0.024	1	-0.073	-0.001	0.082	0.065	0.172	0.097
NSF		0.507 **	0.278	0.530 **	-0.016	0.079	-0.078	1	0.080	0.138	0.015	0.214	0.078
HSW		-0.058	0.256	-0.055	0.031	0.140	0.000	0.084	1	0.303 *	0.299 *	-0.196	0.113
NFV		0.468 **	0.132	0.448 *	0.347	0.608**	0.083	0.137	0.306	1	0.909**	-0.278 *	0.647**
NFH		0.465 **	0.133	0.439 *	0.403 *	0.656**	0.073	-0.002	0.352	0.994 **	1	-0.360**	0.605**
FRM		-0.054	0.075	0.002	-0.368 *	-0.214	0.194	0.213	-0.254	-0.332	-0.463 *	1	-0.233
FYPV		0.526 **	0.326	0.502**	0.249	0.953**	0.098	0.081	0.115	0.648 **	0.667 **	-0.270	1

VL (m) – Vine Length (m); IL (cm) – Internodal Length (cm); NNV – Number of Nodes per Vine; SR – Sex Ratio; AFW (g) – Average Fruit Weight (g); FS (%) – Fruit Set (%); NSF – Number of Seeds per Fruit; HSW (g) – Hundred Seed Weight (g); NFV – Number of Fruits per Vine; NFH – Number of Fruits per Harvest; FRM – Firmness (kg/cm$^{2)}$;FYPV (kg) – Fruit Yield per Vine (kg).

association with fruit yield (0.249G, 0.249P) and was positively associated with number of fruits per vine (0.347G, 0.347P), number of fruits per harvest (0.403G, 0.372P) and average fruit weight (0.276G, 0.276P). However, it showed a strong negative association with fruit set (-0.743G, -0.738P), indicating that favourable sex expression did not necessarily result in higher fruit setting. Fruit set itself showed only a weak positive association with fruit yield (0.098G, 0.097P). Therefore, fruit set alone may not be sufficient as a selection criterion for higher yield, as fruit number, fruit size and individual fruit weight appeared to contribute more strongly to total productivity.

Seed-related characters showed comparatively weak associations with fruit yield. Number of seeds per fruit showed a positive but non-significant association with yield (0.081G, 0.078P), while hundred-seed weight also exhibited a positive but non-significant association (0.115G, 0.113P). Number of seeds per fruit was positively associated with vine length (0.507G, 0.503P), number of nodes per vine (0.530G, 0.512P) and internodal length (0.278G, 0.273P), whereas hundred-seed weight was positively associated with number of fruits per vine (0.306G, 0.303P), number of fruits per harvest (0.352G, 0.299P) and average fruit weight (0.140G, 0.138P). These findings suggest that seed characters had a limited direct association with fruit yield compared with fruit number, fruit size and fruit weight.

In contrast, fruit firmness showed a negative association with fruit yield at both genotypic and phenotypic levels (-0.270G, -0.233P). Fruit firmness was also negatively associated with average fruit weight (-0.214G, -0.188P), number of fruits per vine (-0.332G, -0.278P) and number of fruits per harvest (-0.463G, -0.360P). Thus, firmer fruits were generally associated with lower yield performance in the present genotypes and may be considered separately when fruit quality rather than yield is the major breeding objective.

Overall, the close similarity between genotypic and phenotypic correlation coefficients for most traits indicates that the observed associations were relatively consistent at both levels. Among all the characters studied, average fruit weight, number of fruits per vine, number of fruits per harvest, vine length and number of nodes per vine showed the strongest positive associations with fruit yield and therefore appear to be the most useful traits for selection of high-yielding ridge gourd genotypes. However, correlation analysis alone cannot distinguish direct effects from indirect effects through other associated traits; hence, path coefficient analysis was carried out to determine the direct and indirect contributions of these characters to fruit yield.

Path Coefficient analysis

Path coefficient analysis was performed to determine the direct and indirect contribution of different traits to

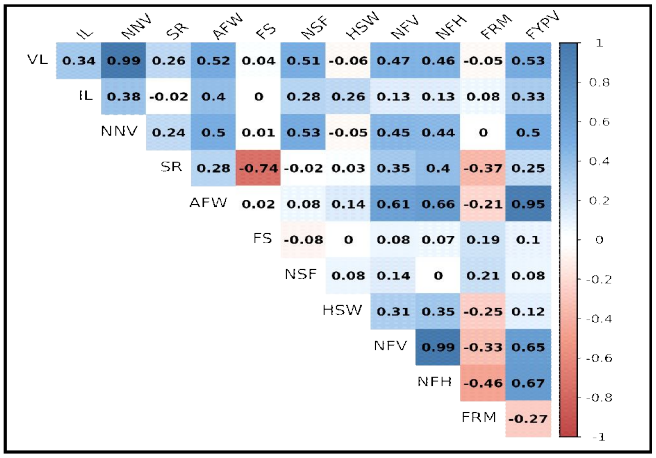


Fig. 1: Genotypic correlogram.

Table 2: Path analysis for direct and indirect effects.

Trait	VL	IL	NNV	SR	AFW	FS	NSF	HSW	NFV	NFH	FRM	FYPV
VL	**-0.087**	-0.014	0.090	0.016	0.476	0.005	0.010	0.001	0.095	-0.073	0.002	0.524
IL	-0.030	**-0.042**	0.034	-0.001	0.365	0.000	0.005	-0.008	0.026	-0.021	-0.005	0.324
NNV	-0.086	-0.015	**0.091**	0.015	0.454	0.001	0.011	0.001	0.090	-0.064	-0.000	0.499
SR	-0.022	0.000	0.021	**0.064**	0.251	-0.100	-0.000	-0.001	0.071	-0.063	0.026	0.248
AFW	-0.045	-0.016	0.045	0.017	**0.913**	0.003	0.001	-0.004	0.124	-0.101	0.014	0.952
FS	-0.003	-0.000	0.000	-0.047	0.021	**0.135**	-0.001	0.000	0.016	-0.011	-0.013	0.097
NSF	-0.044	-0.011	0.046	-0.000	0.069	-0.009	**0.021**	-0.002	0.028	-0.002	-0.017	0.077
HSW	0.004	-0.010	-0.004	0.002	0.126	-0.000	0.001	**-0.032**	0.062	-0.050	0.015	0.113
NFV	-0.041	-0.005	0.040	0.022	0.554	0.011	0.003	-0.009	**0.204**	-0.154	0.021	0.647
NFH	-0.037	-0.005	0.034	0.024	0.545	0.008	0.000	-0.009	0.186	**-0.169**	0.028	0.605
FRM	0.002	-0.002	0.000	-0.021	-0.170	0.023	0.004	0.006	-0.056	0.061	**-0.079**	-0.232

VL (m) – Vine Length (m); IL (cm) – Internodal Length (cm); NNV – Number of Nodes per Vine; SR – Sex Ratio; AFW (g) – Average Fruit Weight (g); FS (%) – Fruit Set (%); NSF – Number of Seeds per Fruit; HSW (g) – Hundred Seed Weight (g); NFV – Number of Fruits per Vine; NFH – Number of Fruits per Harvest; FRM – Firmness (kg/cm^2)FYPV (kg) – Fruit Yield per Vine (kg).

fruit yield per vine. Average fruit weight recorded the highest positive direct effect (0.913), followed by number of fruits per vine (0.204), fruit set (0.135), number of nodes per vine (0.091), sex ratio (0.064) and number of seeds per fruit (0.021). In contrast, vine length (-0.087), internodal length (-0.042), hundred-seed weight (-0.032), number of fruits per harvest (-0.169) and fruit firmness (-0.079) recorded negative direct effects. The high positive direct effect of average fruit weight was supported by its strong positive correlation with fruit yield per vine (0.952), indicating that average fruit weight was the most important trait contributing directly to yield. Its major positive indirect effects were observed through number of fruits per vine (0.124) and number of nodes per vine (0.045), while negative indirect effects were observed through number of fruits per harvest (-0.101) and internodal length (-0.016). The strong direct contribution of average fruit weight indicates that selection for higher fruit weight may be effective for improving fruit yield in ridge gourd. Similar importance of average fruit weight was reported by Rabbani *et al.*, (2012), Varalakshmi *et al.*, (2015), Ramesh *et al.*, (2018), Gowda (2020) and Madhavi *et al.*, (2023).

Number of fruits per vine showed a positive direct effect (0.204) and a strong positive correlation with fruit yield per vine (0.647). Its major positive indirect effect was through average fruit weight (0.554), followed by number of nodes per vine (0.040) and number of fruits per harvest (-0.154). The negative contribution through number of fruits per harvest indicates an antagonistic relationship between these yield components in their contribution to total yield. Other indirect effects were relatively small, including those through vine length (-0.041), internodal length (-0.005), sex ratio (0.022), fruit set (0.011), number of seeds per fruit (0.003), hundred-seed weight (-0.009) and fruit firmness (0.021). The results suggest that higher number of fruits per vine contributed positively to yield, particularly through its strong association with average fruit weight. Similar results were reported by Rabbani *et al.*, (2012), Harshitha *et al.*, (2019) and Akhila and Singh (2020).

Number of fruits per harvest exhibited a negative direct effect (-0.169) despite its positive correlation with fruit yield per vine (0.605). Its major positive indirect effect was through average fruit weight (0.545), followed by number of fruits per vine (0.186). Other positive indirect effects were observed through sex ratio (0.024), fruit set (0.008), number of seeds per fruit (0.000), hundred-seed weight (-0.009), and fruit firmness (0.028), while negative contributions were observed through vine length (-0.037), internodal length (-0.005) and number of nodes per vine (0.034). The positive correlation of number of fruits per harvest with fruit yield, despite its negative direct effect, indicates that its association with yield was mainly mediated through other productive traits, particularly average fruit weight and number of fruits per vine. Similar observations were reported by Rabbani *et al.*, (2012),

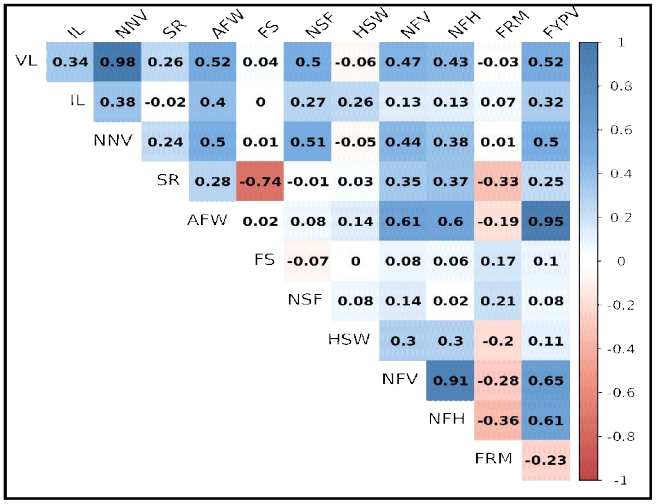


Fig. 2: Phenotypic correlogram.

Harshitha *et al.,* (2019) and Madhavi *et al.,* (2023).

Vine length showed a negative direct effect (-0.087) but exhibited a positive correlation with fruit yield per vine (0.524). This positive association was mainly due to its positive indirect effect through average fruit weight (0.476), followed by number of fruits per vine (0.095) and number of nodes per vine (0.090). Small positive indirect effects were also observed through sex ratio (0.016), fruit set (0.005), number of seeds per fruit (0.010) and hundred-seed weight (0.001), whereas negative indirect effects occurred through internodal length (-0.014) and number of fruits per harvest (-0.073). Thus, vine length appeared to influence fruit yield mainly through its favourable association with average fruit weight, number of fruits per vine and number of nodes per vine rather than through its direct effect.

Internodal length recorded a negative direct effect (-0.042) but showed a positive correlation with fruit yield per vine (0.324). Its major positive indirect effect was through average fruit weight (0.365), followed by number of fruits per vine (0.026) and number of nodes per vine (0.034). Positive contributions were also observed through fruit set (0.000), number of seeds per fruit (0.005) and fruit firmness (-0.005), while relatively small negative indirect effects occurred through vine length (-0.030), sex ratio (-0.001), hundred-seed weight (-0.008) and number of fruits per harvest (-0.021). These results indicate that internodal length contributed to yield primarily through its association with average fruit weight and other yield-related characters rather than through a direct positive effect.

Number of nodes per vine recorded a positive direct effect of 0.091 and showed a positive correlation with fruit yield per vine (0.499). Its major positive indirect effect was through average fruit weight (0.454), followed by number of fruits per vine (0.090) and internodal length (-0.015). It also showed positive indirect effects through fruit set (0.001), number of seeds per fruit (0.011) and hundred-seed weight (0.001), while negative contributions were observed through vine length (-0.086) and number of fruits per harvest (-0.064). The positive direct effect and favourable indirect contribution through average fruit weight suggest that number of nodes per vine may be useful in selection for higher fruit yield.

Sex ratio showed a positive direct effect of 0.064 and a positive but relatively weak correlation with fruit yield per vine (0.248). Its major positive indirect effects were through average fruit weight (0.251) and number of fruits per vine (0.071), whereas negative indirect effects were observed through fruit set (-0.100) and number of fruits per harvest (-0.063). The remaining indirect effects were relatively small. These results indicate that sex ratio may contribute to yield both directly and indirectly, particularly through its association with average fruit weight and fruit number.

Fruit set exhibited a positive direct effect of 0.135, but its correlation with fruit yield per vine was low and positive (0.097). Its major positive indirect effect was through average fruit weight (0.021), while negative indirect effects were observed through sex ratio (-0.047) and fruit firmness (-0.013). The remaining indirect effects were negligible. Thus, although fruit set showed a positive direct contribution, its overall association with fruit yield was relatively weak, suggesting that fruit set alone may not be a sufficient selection criterion for improving yield.

Number of seeds per fruit recorded a small positive direct effect of 0.021 and showed a weak positive correlation with fruit yield per vine (0.077). Its major positive indirect effects were through average fruit weight (0.069), number of nodes per vine (0.046) and number of fruits per vine (0.028). Negative indirect effects were observed through fruit set (-0.009), fruit firmness (-0.017) and vine length (-0.044). These findings indicate that number of seeds per fruit had only a limited direct contribution to fruit yield compared with major yield components such as average fruit weight and fruit number.

Hundred-seed weight recorded a negative direct effect (-0.032) and showed a weak positive correlation with fruit yield per vine (0.113). Its positive indirect effects were mainly through average fruit weight (0.126) and number of fruits per vine (0.062), while negative indirect effects were observed through internodal length (-0.010), number of nodes per vine (-0.004), number of fruits per harvest (-0.050) and fruit firmness (0.015). The weak overall association with fruit yield and negative direct effect indicate that hundred-seed weight had limited importance as a direct selection criterion for yield improvement.

Fruit firmness recorded a negative direct effect (-0.079) and showed a negative correlation with fruit yield per vine (-0.232). Its indirect effects were relatively small, with positive contributions through average fruit weight (-0.170), fruit set (0.023), hundred-seed weight (0.006) and number of fruits per harvest (0.061), while negative effects were observed through vine length (0.002), internodal length (-0.002), sex ratio (-0.021), number of seeds per fruit (0.004) and number of fruits per vine (-0.056). The negative direct effect and negative overall correlation indicate that fruit firmness was unfavourably associated with fruit yield in the present set of genotypes and may therefore be considered separately when fruit quality is given greater emphasis than yield.

Conclusion

Correlation and path coefficient analyses revealed that average fruit weight and number of fruits per vine were the most important traits associated with fruit yield per vine. Average fruit weight showed the strongest positive correlation with yield (0.952) and the highest positive direct effect (0.913), indicating its major role in determining yield. Number of fruits per vine also exhibited a positive correlation with yield (0.647) and a positive direct effect (0.204). The positive correlations of number of fruits per harvest (0.605), vine length (0.524) and internodal length (0.324) with yield, despite their negative direct effects (-0.169, -0.087 and -0.042, respectively), indicated that their association with yield was mainly through other component traits, particularly average fruit weight and fruit number. Overall, average fruit weight and number of fruits per vine can be considered important selection criteria for improving fruit yield, and simultaneous selection for these traits may be effective in improving fruit yield in ridge gourd.

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