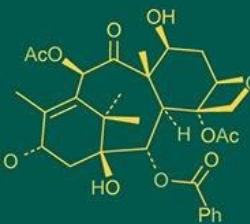
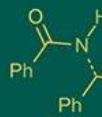


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(2): 616-618
www.biochemjournal.com
Received: 20-11-2025
Accepted: 24-12-2025

Rajshree Gayen
Principal Scientist,
Department of Vegetable
Science, College of Agriculture,
IGKV, Raipur, Chhattisgarh,
India

Kiran N
M.Sc. Research Scholar,
Department of Vegetable
Science, College of Agriculture,
IGKV, Raipur, Chhattisgarh,
India

Jitendra Trivedi
Principal Scientist,
Department of Vegetable
Science, College of Agriculture,
IGKV, Raipur, Chhattisgarh,
India

Corresponding Author:
Kiran N
M.Sc. Research Scholar,
Department of Vegetable
Science, College of Agriculture,
IGKV, Raipur, Chhattisgarh,
India

Evaluation of onion (*Allium cepa* L.) hybrids suitable for Chhattisgarh plains

Rajshree Gayen, Kiran N and Jitendra Trivedi

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i2Sh.7688>

Abstract

The research titled "Evaluation of Onion (*Allium cepa* L.) hybrids suitable for Chhattisgarh plains" was carried out during 2024-25 at IGKV, Raipur. Correlation and path coefficient analysis studied using fifteen onion hybrids in a Randomized Block Design with three replications. A wide range of variability was observed across all studied characters. Among the hybrids, RHB-24-85, RHA-24-74, and RHA-24-72 produced the highest bulb yields. Total bulb yield showed strong positive correlations with average bulb weight, marketable yield, fresh bulb weight, number of leaves, plant height and leaf length. Path coefficient analysis revealed that marketable yield, plant height, equatorial diameter, number of leaves per plant, average bulb weight, neck length and fresh bulb weight exerted positive direct effects on total yield.

Keywords: Onion, correlation, path analysis

Introduction

Onion (*Allium cepa* L.) a major bulb crop belonging to the family Amaryllidaceae, originates from Central Asia and the Mediterranean region. Nearly 750 known *Allium* species (Yousaf *et al.*, 2004) [20], only seven are cultivated. Its chromosome number is $2n = 2x = 16$. It is cultivated as an annual for bulb production and a biennial for seed production. onion is highly cross-pollinated due to protandry. Globally, onions are consumed as food, spice and medicine, valued for their flavour, aroma and therapeutic properties (Selvaraj, 1976; Griffiths *et al.*, 2002) [15, 7]. Their pungency is attributed to sulphur compounds such as allyl propyl disulphide ($C_6H_{12}S_2$), while anthocyanin and quercetin impart red pigmentation and skin colour respectively (Augusti, 1990; Hanley & Fenurick, 1985) [2, 9]. Nutritionally, onion is a rich source of vitamins (C, K, B-complex), minerals, fibre and bioactive compounds with antioxidant and antifungal properties (Shankaracharya, 1974; Pareek *et al.*, 2017) [16, 13].

In India, onion is cultivated in three seasons, viz. *Kharif*, *late Kharif*, and *Rabi*. *Rabi* contributing nearly 60% of total production. India ranks second in global onion production, with Maharashtra as the leading producer. In Chhattisgarh, onion covers 23.63 thousand ha with a productivity of 16.46 MT/ha, mainly concentrated in Raipur, Durg, Raigarh, and adjoining districts.

Considerable variation exists among onion varieties in bulb size, colour, pungency and storage quality. Onion hybrids have gained prominence in modern horticulture due to their higher productivity, disease resistance, uniform maturity and better storability. They express hybrid vigour, stress tolerance and wide adaptability. Current breeding priorities focus on developing short-duration, bolting-resistant, and long shelf-life hybrids.

Materials and Methods

The field experiment was carried out during the rabi season of 2024-25 at the Horticulture Research cum Instructional Farm, Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. The study evaluated 15 onion hybrids sourced from the All-India Network Research Project on Onion and Garlic (AINRPOG) for their adaptability to Chhattisgarh plains. The trial was arranged in a Randomized Block Design (RBD) with three replications, using a plot size of 4.5 m² (2.25 m × 2.0 m) and plant spacing of 15 cm × 10 cm. Standard crop management practices recommended for onion cultivation were adopted to ensure optimal growth. Observations were recorded on characters such as

plant height (cm), number of leaves per plant, leaf length (cm), neck thickness (cm), neck length (cm), polar and equatorial diameter (cm), average bulb weight(g), marketable yield(q/ha), bulb fresh weight(kg/plot) and total yield (q/ha) growth and yield parameters. Data were subjected to statistical analysis. Genotypic and phenotypic correlations were calculated following Al-Jibouri *et al.* (1958) ^[1], and path coefficient analysis to partition direct and indirect effects of characters on yield was carried out by the method of Dewey and Lu (1959) ^[5]

Results and Discussion

Correlation Studies

Genotypic correlation coefficients were higher than phenotypic ones for all the characters studied, suggesting a strong inherent association among the characters (Table 1). Correlation analyses are crucial for identifying promising characters, as phenotypic expression is often influenced by the environment. Total bulb yield showed strong and significant positive correlations with average bulb weight (0.983 and 0.860), marketable yield (0.990 and 0.994), fresh bulb weight (0.983 and 0.990), number of leaves per plant (0.893 and 0.519), plant height (0.691 and 0.470) and leaf length (0.631 and 0.440) at both genotypic and phenotypic levels. Additional positive but comparatively weaker associations were observed with equatorial diameter (0.529 and 0.157), polar diameter (0.366 and 0.351) and neck thickness (0.543 and 0.192).

Average bulb weight was positively associated with the number of leaves (0.826 and 0.656), plant height (0.665 and

0.502), leaf length (0.705 and 0.521), neck thickness (0.712 and 0.281), and equatorial diameter (0.532 and 0.288). Similarly, marketable yield exhibited significant positive correlations with average bulb weight (0.924 and 0.858), number of leaves (0.907 and 0.545), plant height (0.692 and 0.479), and leaf length (0.630 and 0.448).

Equatorial diameter was strongly correlated at the genotypic level with plant height (0.941), leaf length (0.975), and polar diameter (0.937). Polar diameter also showed positive associations with plant height (0.748 and 0.515) and leaf length (0.825 and 0.491). Neck thickness correlated positively with leaf length (0.785 and 0.361) and plant height (0.579 and 0.477), while leaf length itself displayed a very strong association with plant height (0.977 and 0.789).

These findings align with earlier reports by Nikhil *et al.* (2015) ^[12], Lakshmi (2015) ^[10], Santra *et al.* (2017) ^[14], Vikram and Jat (2018) ^[18] and Yogita *et al.* (2021) ^[19], who also emphasized the positive role of morphological characters in yield enhancement. The positive correlations of bulb yield with average bulb weight, fresh bulb weight, and marketable yield were consistent with the results of Mane *et al.* (2019) ^[11], Deb and Ara (2016) ^[4] and Hanci (2018) ^[8].

In summary, the correlation analysis demonstrated that total bulb yield is predominantly governed by key yield-contributing characters such as bulb weight, marketable yield, fresh bulb weight, plant height, number of leaves, and leaf length. Hence, concurrent selection for these characters could be an efficient strategy to improve bulb yield in rabi onion breeding programs.

Table 1: Genotypic and phenotypic coefficient correlation analysis of onion hybrids among different characters

		PH	NOL	LL	NT	NL	PD	ED	ABW	MY	NBPP	BFW	TY
PH	G	1	0.350*	0.977**	0.579**	0.341*	0.748**	0.941**	0.665**	0.692**	0.138	0.780**	0.691**
	P	1	0.197	0.789**	0.477**	0.314*	0.515**	0.461**	0.502**	0.479**	0.191	0.490**	0.470**
NOL	G		1	0.567**	0.314*	0.375*	0.421**	0.543**	0.826**	0.907**	0.359*	0.939**	0.893**
	P		1	0.313*	0.238	0.24	0.386**	0.321*	0.656**	0.545**	0.057	0.495**	0.519**
LL	G			1	0.785**	0.594**	0.825**	0.975**	0.705**	0.630**	0.043	0.745**	0.631**
	P			1	0.361*	0.371*	0.491**	0.421**	0.521**	0.448**	0.096	0.472**	0.440**
NT	G				1	0.104	0.214	0.712**	0.758**	0.578**	-0.639**	0.701**	0.543**
	P				1	0.216	0.16	0.281	0.420**	0.21	-0.366*	0.231	0.192
NL	G					1	0.689**	0.561**	0.273	0.146	-0.117	0.126	0.179
	P					1	0.415**	0.483**	0.19	-0.02	-0.148	-0.043	-0.003
PD	G						1	0.937**	0.369*	0.375*	0.372*	0.406**	0.366*
	P						1	0.588**	0.375*	0.363*	0.026	0.365*	0.351*
ED	G							1	0.532**	0.584**	-0.01	0.645**	0.529**
	P							1	0.288	0.188	0.015	0.176	0.157
ABW	G								1	0.924**	-0.1	0.983**	0.941**
	P								1	0.858**	0.106	0.856**	0.860**
MY	G									1	0.377*	0.989**	0.990**
	P									1	0.489**	0.988**	0.994**
NBPP	G										1	0.181	0.384**
	P										1	0.478**	0.501**
BFW	G											1	0.983**
	P											1	0.990**

** Significant at 1 % and * Significant at 5 % ; PH, Plant height (cm); NOL, Number of leaves per plant; LL, Leaf length (cm); NT, Neck thickness (cm); NL, Neck length (cm); PD, Polar diameter (cm); ED, Equatorial diameter (cm); ABW, Average bulb weight (g); MY, Marketable yield (q/ha); NBPP, Number of bulbs per plot; BFW, Bulb fresh weight (kg/plot); TY, Total bulb yield (q/ha).

Path coefficient analysis

Path coefficient analysis further aids in determining the direct and indirect contributors to yield. The path analysis revealed that total bulb yield was most positively influenced directly on marketable yield (1.646), followed by plant height (0.524), equatorial diameter (0.335), average bulb

weight, number of leaves per plant (0.249), neck length (0.143) and bulb fresh weight (0.006). Comparable findings were also reported by Nikhil *et al.* (2015) ^[12], Santra *et al.* (2017) ^[14] and Dinkar and Sharma (2017) ^[6], Yogita *et al.* (2021) ^[19]. Conversely, the negative direct effect was observed for leaf length (-0.882), followed by number of

bulbs per plot (-0.562), neck thickness (-0.274) and polar diameter (-0.032). Nevertheless, characters such as leaf length and neck thickness contributed positively to yield indirectly through their associations with major characters like marketable yield and plant height. The residual effect at the genotypic level was found to be low, indicating that

most of the variability in total yield was explained by the studied characters. Overall, marketable yield, plant height, equatorial diameter, and number of leaves per plant were identified as the most influential characters, which should be given priority while selecting onion hybrids for yield enhancement.

Table 2: Path coefficient analysis of onion hybrids among different Characters

	PH	NOL	LL	NT	NL	PD	ED	ABW	MY	NBPP	BFW	TY
PH	0.524	0.087	-0.861	-0.158	0.049	-0.024	0.389	-0.381	1.14	-0.078	0.005	0.691**
NOL	0.183	0.249	-0.5	-0.086	0.053	-0.014	0.182	-0.473	1.493	-0.202	0.006	0.893**
LL	0.512	0.141	-0.882	-0.215	0.085	-0.027	0.404	-0.404	1.036	-0.024	0.005	0.631**
NT	0.303	0.078	-0.692	-0.274	0.015	-0.007	0.239	-0.435	0.952	0.359	0.004	0.543**
PD	0.178	0.094	-0.524	-0.028	0.143	-0.022	0.188	-0.157	0.24	0.066	0.001	0.179
ED	0.392	0.105	-0.727	-0.059	0.098	-0.032	0.39	-0.212	0.618	-0.209	0.003	0.366*
ABW	0.609	0.135	-1.063	-0.195	0.08	-0.037	0.335	-0.305	0.961	0.006	0.004	0.529**
MY	0.348	0.206	-0.621	-0.208	0.039	-0.012	0.178	0.301	0.648	0.056	0.006	0.941**
NBPP	0.363	0.226	-0.555	-0.158	0.021	-0.012	0.196	-0.53	1.646	-0.212	0.006	0.990**
BFW	0.072	0.089	-0.038	0.175	-0.017	-0.012	-0.003	0.057	0.621	-0.562	0.001	0.384**
TY	0.409	0.234	-0.657	-0.192	0.018	-0.013	0.216	-0.563	1.627	-0.102	0.006	0.983**

Residual effect 0.0491

PH, Plant height (cm); NOL, Number of leaves per plant; LL, Leaf length (cm); NT, Neck thickness (cm); NL, Neck length (cm); PD, Polar diameter (cm); ED, Equatorial diameter (cm); ABW, Average bulb weight (g); MY, Marketable yield (q/ha); NBPP, Number of bulbs per plot; BFW, Bulb fresh weight (kg/plot); TY, Total bulb yield (q/ha).

Conclusion

The investigation demonstrated considerable genetic variability among the evaluated onion hybrids, with RHB-24-85, RHA-24-74, and RHA-24-72 performing best in terms of yield. Total yield was found to be predominantly governed by marketable yield, plant height, average bulb weight and number of leaves, emphasizing these attributes as the most critical selection parameters for breeding high-yielding onion hybrids adaptable to the Chhattisgarh plains.

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