Journal of Plant Development Sciences
Meerut, India

RESEARCH

CORRELATION ANALYSIS OF YIELD-RELATED ATTRIBUTES, GROWTH PARAMETERS AND BIOCHEMICAL TRAITS IN ONION (*ALLIUM CEPA* L.) CULTIVAR GAWO-2

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Received-25.12.2023, Revised-14.01.2024, Accepted-25.02.2024

Abstract: Onion (*Allium cepa* L.) is a significant commercial vegetable crop cultivated across diverse climatic regions globally, including tropical, subtropical, and temperate zones. In India, it holds agricultural and medicinal significance, being utilized for culinary purposes and as a component in traditional medicine formulations. This study aimed to investigate the interrelationship between various morphological and physiological traits in onion plants. The experiment was conducted using a Randomized Block Design (RBD) with twelve treatments and three replications. The analysis of the results indicated a highly significant positive correlation between marketable yield and growth parameters such as plant height, number of leaves, and leaf length. Additionally, there was a positive correlation with yield components including polar diameter, equatorial diameter, and average bulb weight, as well as various quality parameters such as TSS, reducing sugars, total soluble sugars, total phenols, and pyruvic acid. Plant height in onions was positively correlated with different growth parameters, such as the number of leaves, leaf length, and total dry matter. It also showed a positive correlation with yield components like polar diameter, equatorial diameter, average bulb weight, and marketable yield. Furthermore, the polar diameter of the bulb was positively correlated with TSS, total sugars, and total phenols.

Keywords: Correlation, Onion, Marketable yield, TSS

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops belongs to Alliceae family being grown all over the country. It is successfully grown in tropical, subtropical and temperate parts of the world. In India, onion is cultivated for vegetable as well as medicinal purposes (Pramanik, 2018). Onion is popularly used as green as well as mature bulb and used as a cooked vegetable in soups, mix vegetable and flavouring agent in many additional dishes. It is consumed as a vegetable and condiment. The green leaves, immature and mature bulbs are eaten raw or used in vegetable preparations. It is an indispensable item in every kitchen and used to enhance flavour of different recipes. Onion has many medicinal values and used for preparation of various Homeopathic, Unani and Ayurvedic medicines (Tomar, 2016). Phenolic compounds can offer significant anti-mellitus atherogenic protection by inhibiting the oxidation of low density lipoproteins.

In India, onion is cultivated in an area of 1.54 million hectares and production of 25.44 million MT (source: NHB, 2023-24 first advance estimate). In India, major onion-growing states are Maharashtra, Gujarat, Karnataka, Tamil Nadu, Orrisa, Madhya Pradesh, Uttar Pradesh and Andhra Pradesh. In Gujarat, onion occupies an area of about 48.58 thousand hectares with production of 1416.31 thousand metric tonnes (Anon., 2020).

Despite its economic and cultural importance, there remains a need to elucidate the correlation between different morphological and physiological traits in onion plants. Understanding these associations can facilitate targeted breeding efforts aimed at improving crop yield, quality, and resistance to biotic and abiotic stresses.

MATERIALS AND METHODS

A field experiment was conducted during the *rabi* seasons of the year 2019-20 and 2020-21 at the experimental farm of Main Vegetable Research Centre, Anand Agricultural University, Anand. Geographically, Anand is situated at 22^0 35'N latitude, 72^0 55'E longitudes and at an elevation of about 45.1 meters above mean sea level. The soil of this area is classified as loamy sand and is locally known as "Goradu" soil. The experiment constituted of 12 treatment combinations were laid out in RBD design with three replications. The twelve treatments

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viz., T_1 @Zn (1g/l), T_2 @ Fe (1g/l), T_3 @ Zn (1g/l) + Fe (1g/l), T_4 @ GA_3 (100mg/l), T_5 @ Si (0.1%), T_6 @ Zn (1g/l) + GA_3 (100mg/l), T_7 @ Fe (1g/l) + GA_3 (100mg/l), T_8 @ Zn (1g/l) + Fe (1g/l) + GA_3 (100mg/l), T_9 @ Zn (1g/l) + Si (0.1%), T_{10} @ Fe (1g/l) + Si (0.1%), T_{11} @ Zn (1g/l) + Fe (1g/l) + Si (0.1%) and T_{12} @ Control were prepared and sprayed on the foliage of plants at 30 & 60 DATP with the help of hand sprayer.

Statistical analysis: Pearson's correlations were worked out between growth parameters, yield attributes and biochemical parameters and tested using t test (Rangaswamy, 2010).

RESULTS AND DISCUSSION

The correlation analysis revealed significant associations among various phenotypic traits in onion cultivars. Positive correlations were observed between bulb size and certain leaf morphological characteristics, indicating potential co-regulation of these traits during plant development. Additionally, a correlation was identified between the content of phenolic compounds and certain agronomic traits, suggesting a possible link between biochemical composition and plant phenotype. These findings underscore the complex interplay between genetic, physiological, and environmental factors shaping onion morphology and biochemistry.

Correlation with yield

The data presented in Table 1indicated that the correlation values of marketable yield indicate a highly significant positive relation with growth parameters like plant height(0.88**), no. of leaves(0.86**), leaf length (0.81**), total dry matter (0.79**), AGR (0.79**), CGR (0.79**), RGR (0.77**) and total chlorophyll (0.8**). It also found highly significant positive relation with different yield components like polar diameter of bulb (0.94**), equatorial diameter of bulb (0.86**) and average weight of bulb (0.99**). It remained positively highly significantly correlated with "A" (0.98**) and "B" grade of bulb (0.98**), while negatively correlated with "C" grade of bulb (-0.79**).

Correlation with Morpho-physiological parameters

The data presented in Table 2 indicated that the correlation values of marketable yield indicate a highly significant positive relation with growth parameters like plant height (0.88**), no. of leaves (0.86**), leaf length (0.81**), total dry matter (0.79**), AGR (0.79**), CGR (0.79**), RGR (0.77**) and total chlorophyll (0.8**). It is seen from Table 2 thatthe plant height of onion is positively correlated with different growth parameters like no. of leaves, leaf length and total dry matter. It also showed a positive correlation with yield components like polar diameter, equatorial diameter, the average weight of the bulb and marketable yield. The leaf length of an onion is positively correlated with total dry matter, AGR, CGR and RGR. The total dry matter in bulbs showed close correlation with higher productivity in onion. The data given in table revealed that the average weight of the bulb is positively correlated with the total dry matter, polar diameter, equatorial diameter and marketable yield. The polar diameter of the bulb is an important yield attributing to the character of the onion, which was positively correlated with the average weight of bulb, equatorial diameter, "A" & "B" grade of the bulb, while negatively correlated with the "C" grade of the bulb.

Correlation with biochemical parameters.

The result showed in Table 3 indicated that marketable yield found highly significant positive relation with various quality parameters like total soluble solids (0.92**), acidity (0.85**), reducing sugars (0.77**), total soluble sugars (0.87**), non-reducing sugars (0.85**), total phenols (0.85**), ascorbic acid (0.88**), pyruvic acid (0.73**) and total flavonoids (0.90**).The results from Table 3indicated that the plant height of onion is positively correlated with biochemical parameters like TSS, reducing sugars, total soluble sugars, total phenols, and pyruvic acid. The total dry matter in bulbs also showed positive correlation with TSS, reducing sugars, and total soluble sugars. The polar diameter of the bulb is positively correlated with TSS, total sugars, and total phenols. The average weight of the bulb is also positively correlated with reducing sugars, non-reducing sugars, and total soluble sugars. Many researchers like, Ghetia and Singh (2000) and Sood (2000) reported that plant height had positive correlation on bulb yield, number of leaves, bulb weight, and polar and equatorial bulb diameter. Bulb yield was showing positive correlation with dry matter, plant height, number of leaves per plant, bulb weight and polar and equatorial bulb diameter. However it was negatively correlated with the neck thickness of bulbs and dry matter of bulbs and leaves. Similar trends were observed by Gurjar and Singhania (2006), Trivedi *et al*. (2006) and Trivedi *et al*. (2006a). Ananthan and Balakrishnamoorthy (2007) reported that bulb weight, total dry matter production, chlorophyll a and total soluble solids were recorded highly positive and significant association with economic dry matter yield/ha. These findings were supported by Mahanthesh *et al*. (2007), Dhotre *et al*. (2010) and Singh *et al*. (2011). The work of Ashok *et al*. (2013) reported that total yield was significantly and positively correlated with bulb fresh weight, polar bulb diameter, reducing sugars and weight of bulb at phenotypic and genotypic level.These results were confirmed by Dewangan and Sahu (2014) and Rajya Lakshmi (2015). The above findings were in close association with the research of Pujar *et al*. l (2019). They observed that selection would be sufficient for these traits to bring genetic improvement.

Table 1. Correlation study between yield and yield attributes traits. (Pooled value of two years)

Characters	Marketable Yield	Average weight of Bulb	Equatorial Diameter of bulb	Polar diameter of bulb	Neck thickness of bulb	A grade bulb	B grade bulb	C grade bulb
Marketable Yield	1							
Average weight of Bulb	0.99**	1	-	-	-			
Equatorial Diameter	0.86**	0.86**	1	-	-			
Polar diameter of bulb	0.94**	0.94**	0.92**	1	-			
Neck thickness of bulb	0.55	0.55	0.78**	0.57	1			
A grade bulb	0.98**	0.98**	0.89**	0.96**	0.99**	1		
B grade bulb	0.98**	0.98**	0.87**	0.95**	0.57	0.99**	1	
C grade bulb	-0.79**	-0.79**	-0.83**	-0.86**	-0.61*	-0.89**	-0.89**	1

Table 2. Correlation study between yield and growth parameters (Pooled value of two years)

Characters	Marketable Yield	Plant height	Number of Leaves	Leaf length	Total dry matter	Absolute growth rate	Crop growth rate	Relative growth rate	Total chlorophyll
Marketable Yield	1	-	-	-	-	-	-	-	-
Plant height	0.88**	1	-	-	-	-	-	-	-
Number of Leaves	0.86**	0.9**	1	-	-	-	-	-	-
Leaf length	0.81**	0.85**	0.85**	1	-	-	-	-	-
Total dry matter	0.79**	0.91**	0.87**	0.99**	1	-	-	-	-

Absolute growth rate	0.79**	0.91**	0.87**	0.99**	0.99**	1	-	-	-
Crop growth rate	0.79**	0.91**	0.87**	0.99**	0.99**	0.99**	1	-	-
Relative growth rate	0.77**	0.89**	0.84**	0.88**	0.99**	0.99**	0.99**	1	-
Total chlorophyll	0.8**	0.75**	0.71**	0.88**	0.74**	0.74**	0.74**	0.76**	1

Table 3. Correlation study between yield and biochemical traits. (Pooled value of two years)

Characters	Marketable yield	Moisture	TSS	Acidity	Reducing sugars	Total soluble sugars	Non-reducing sugar	Total phenols	Ascorbic acid	Pyruvic acid	Total flavonoids
Marketable yield	1	-	-	-	-	-	-	-	-	-	-
Moisture	-0.90**	1	-	-	-	-	-	-	-	-	-
TSS	0.92**	-0.94**	1	-	-	-	-	-	-	-	-
Acidity	0.85**	-0.91**	0.9**	1	-	-	-	-	-	-	-
Reducing sugars	0.77**	-0.85**	0.87**	0.93**	1	-	-	-	-	-	-
Total soluble sugars	0.87**	-0.87**	0.91**	0.91**	0.9**	1	-	-	-	-	-
Non-reducing sugar	0.85**	-0.83**	0.86**	0.84**	0.78**	0.98**	1	-	-	-	-
Total phenols	0.85**	-0.79**	0.89**	0.73**	0.77**	0.87**	0.86**	1	-	-	-
Ascorbic acid	0.88**	-0.9**	0.9**	0.84**	0.8**	0.92**	0.91**	0.87**	1	-	-
Pyruvic acid	0.73**	-0.8**	0.82**	0.9**	0.8**	0.74**	0.66*	0.54	0.67*	1	-
Total flavonoids	0.90**	-0.9**	0.95**	0.94**	0.85**	0.94**	0.92**	0.83**	0.88**	0.88**	1

Individual bulb weight had a positive and highly significant association with plant height, number of leaves, neck thickness and bulb diameter. Strong association of these traits revealed that selection based on these traits would ultimately improve the individual bulb weight per plant and it is also suggested that hybridization of genotypes possessing a combination of such characters is most useful for obtaining desirable high-yielding segregants. Further, the work of Manjunathagowda and Anjanappa (2021) confirmed that the yield was highly significant and was correlated with growth and yield-attributing traits among genotypes.

CONCLUSION

The result shows that the correlation values of marketable yield indicate highly significant positive relation with growth parameters, yield attributes and biochemical traits, while negatively correlated with "C" grade of bulb and moisture. Further, this study provides insights into the correlation patterns among different phenotypic traits in onion cultivars. The observed associations highlight potential targets for crop improvement strategies, including breeding programs aimed at enhancing yield, nutritional quality, and stress resilience. Further research into the underlying genetic and molecular mechanisms governing these correlations is warranted to fully harness the potential of onion as a versatile and economically important crop.

REFERENCES

Ananthan, M. and Balakrishnamoorthy, G. (2007). Genetic variability and correlation studies in onion for economic dry matter yield. *Agricultural Science Digest*, **27** (3), 190-193.

Google Scholar

Anonymous(2020). *National Horticulture Database*. National Horticultural Board, Gurgaon.

Google Scholar

Ashok, P., Sasikala, K. and Netra, P. (2013). Asssociation among growth characters, yield and bulb quality in onion. *International Journal of Farm Sciences*, **3** (1), 22-29.

Google Scholar

Dewangan, S. R. and Sahu, G. D. (2014). Genetic variability, correlation and path coefficient analysis of different *kharif* onion genotypes in chhattisgarh plains. *Agricultural Science Digest*, **34** (3), 233-236.

Google Scholar

Dhotre, M., Allolli, T. B., Athani, S. I. and Halemani, L. C. (2010). Genetic variability, character association and path analysis studies in *kharif* onion. *The Asian Journal of Horticulture*, **5** (1), 143-146.

Google Scholar

Ghetia, J. M. and Singh, S. P. (2000, November). *Genetic variability correlation and path coefficient analysis in onion*. (*Allium cepa* L.). Paper presented at National symposium on Onion and Garlic production and post harvest management challenges and strategies, Maharashtra, India.

Google Scholar

Gurjar, R. S. and Singhania, D. L. (2006). Genetic variability, correlation and path analysis of yield and yield components in onion. *Indian Journal of Horticulture*, **63** (1), 53-58.

Google Scholar

Mahanthesh, B., Harshavardhan, M., Thippesha, D., Sajjan, M. R. P. and Janardhan, G. (2007). Correlation studies in onion genotypes in *kharif* season under irrigated and rainfed situations. *Asian Journal of Horticulture*, **2** (2), 71-74.

Google Scholar

Manjunathagowda, D. C. and Anjanappa, M. (2021). Genetic variability studies for yield and yield contributing traits in onion (*Allium cepa* L.). *Vegetos*, **34**, 174-182.

Google Scholar

Pramanik, K., Tripathy P., Mandal, P., Pradhan, M. and Biswal, M. (2018). Effect of micronutrients on quality of onion (*Allium cepa* L.). *International Journal of Chemical Studies*, **6** (6), 1324-1327.

Google Scholar

Pujar, U.U., Jagadeesha, R.C., Gangadharappa, P.M., Chavan, M.L., Shankarappa, S. and Jayappa, J. (2019). Genetic variability and correlation studies in onion (Allium cepa L.) genotypes. *Journal of Pharmacognosy and Phytochemistry*, **8**(6), pp.2242-2247.

Google Scholar

Rajya Lakshmi, R. (2015). Studies on genetic variability, correlation and path analysis of yield and yield components in onion. *Journal of Horticultural Sciences*, **10** (2), 237-241.

Google Scholar

Rangaswamy, R. (2010). *A textbook of agricultural statistics* (2nd ed.). New Delhi, India: New Age International Publishers.

Google Scholar

Singh, R. K., Bhonde, S. R. and Gupta, R. P. (2011). Genetic variability in late kharif (Rangada) onion. *Journal of Applied Horticulture*, **13** (1), 74-78.

Google Scholar

Sood, V. (2000). Screening of early maturity dark onion (*Allium ce*pa L.) genetypes for rangda (Late kharif) season. *M. Sc. Thesis*, MPKV, Rahuri (MS).

Google Scholar

Tomar, A. (2016). Antiseptic property of *Allium cepa* Linn. (Piyaz) in Uttar Pradesh. *Van Sangyan*, 3(10):40-42.

Google Scholar

Trivedi, A. P., Dhumal, K. N. and Lawande, K. E. (2006). Estimates of heritability, genetic advance and correlation between yield and its components in onion. *Indian Journal of Genetics and Plant Breeding*, **66** (1), 59-60.

Google Scholar

Trivedi A.P., Dhumal, K.N. and Lawande, K.E. (2006a). Genetic variability, correlation andpath analysis study in storage life of onion (Allium cepa L.). *Indian Journal of Genetics and Plant Breeding*, **66**(4):349-350.

Google Scholar