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Correlation and Path Coefficient analysis in Onion (*Allium cepa* L.) Germplasm under Western Uttar Pradesh Conditions

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ABSTRACT

The present investigation was carried out at Horticulture Research Centre (HRC) of SVPUAT, Meerut, U.P, 2020-21 and 2021-22, to study the correlation and path coefficient analysis among 10 germplasm of Onion (Allium cepa .L) genotypes based on morphological characters. The experiment was laid down in randomized block design (RBD) with three replications. Analysis of variance for 10 genotypes of Onion revealed significant difference for all the 9 parameters, which indicated the presence of wide spectrum of variability among the genotypes. The phenotypic coefficient of variation (PCV) was higher than the respective genotypic coefficient of variation (GCV) for all the traits. High heritability and genetic advance as per cent of mean were observed for all nine characters. The highest heritability was recorded in Yield per ha (98.07%) and lowest for Bulb Diameter (71.66%). Correlation coefficient studies indicated that genotypic correlation coefficient was found to be higher than phenotypic correlation coefficients for most of the characters, indicating a strong inherent association between various characters and due to which it is affected by environmental components in regard to phenotypic expression. Yield per (q) ha expressed highly significant and positive correlation with seed yield per plot (kg) Path coefficient analysis revealed that highest positive direct effect on yield per ha (q), was observed for yield per plot per (kg), height of the plant (cm),fresh bulb wight (gm), bulb diameter(cm) and no. of leaf plant observed very high which indicates that these characters play the significant role to increase the yield per ha(q).High but negative direct effect exhibited by leaf length ,dry bulb weight and duration of crop(days) on yield kg per ha (q) at genotypic level, therefore these characters may be selected for onion crop improvement.

Keywords: *Onion, Correlation and Path coefficient*

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INTRODUCTION

Onion (*Allium cepa* L.) is the main crop among the Bulbous Group. It is used as Salad, and Vegetable as raw and Cooked. It's also used as spices. It is grown all over the World. The notable Onion growing countries are China, India, USA, Japan, Nether land; Spain & Turkey. Out of these India and China is the Leading onion growing countries. In India Maharashtra, Gujarat and Uttar Pradesh are the major Onion growing States. Onion crop has gained importance as a cash crop rather than Vegetable crops because very high export potential. India in spite of being a major Onion producing country has Very Low Productivity about 11 tones /Ha. The World average productivity is about 14.3 Tones/Ha. Onion Productivity affected by Varieties, growing Season and adopted the production techniques .Among the above, Varieties play effective role to enhance the Productivities. Therefore, to enhance the Productivity of Onion Present Study on Characterization and evaluation of Different Germ plasma of Onion was conducted. Genetic variability is an essential perquisite for crop improvement programme for obtaining high yielding varieties. Because of their flavour and culinary resemblance to cereals, amaranths, which are not grasses, are referred to as pseudo-cereals. Heritability is an index for assessing the influence of environment on genotypic expression. Broad sense heritability estimates the proportion of phenotypic variance resulting due to genetic cause(Lush, 1949). Genetic advance denotes the improvement in the genotypic value of the new population when compared to the original population. An estimate of genetic advance along with heritability is helpful in assessing the reliability of character for selection (Lynch and

Walsh, 1998). Path coefficient analysis usually correlates coefficients into direct and indirect effects of various yield components, statistically; path coefficient is a standardized partial regression coefficient, obtained from equations, where the yield related variables are expressed as deviations from the means in units of standard deviation (Steel and Torrie, 1980).Correlation and path co-efficient analysis determines nature and magnitude of association among variables and is the measurement of direct influence of one variable upon the other. All these measures are important for the identification of genetically distant parental combinations, aiming to use distinct gene sets in crossings for getting superior hybrids and sergeant (Goncalves et al., 2008).

MATERIALS AND METHODS

This study Characterization and evaluation of Different germplasm of Onion was conducted at Horticulture Research Center of SVPUA &T, Modipuram, and Meerut U.P. during 2020-21 and 2021-22. The experiment was laid down in Randomized block design with 03 replications. In this study ten diverse germplasm were collected different Places and sown well prepared nursery Beds both years. Before sowing the seed was treated with captain @ 2gram per kg Seeds. To prevent the Damping–off disease at Nursery stage. After that all activities like Irrigation, weed management and Plant protection activities were conducted as per scientific manner when it's needed. Forty days old Nursery was transplanted in 20-21 December both years in well prepared plots. The Nutrient management was done as recommended dose of Fertilizers as Basal and Top Dressing. Cultural activities like irrigation, weed management and Plants Protection were conducted time to time as per need. The Observation was recorded as per proposed technical program me time to time.

RESULTS AND DISCUSSION

The analysis of variance revealed highly significant differences among all 10 genotypes of onion for all 9 characters suggesting considerable genetic variability in the population (Table 1). The phenotypic coefficient of variation (PCV) was higher than the respective genotypic coefficient of variation (GCV) for all the traits. High heritability was observed for all nine characters (Table 2). The highest heritability was recorded in yield per ha (98.07%) and lowest for bulb diameter (71.66%). Yield per Ha (q). Character showing high heritability, could be sowing to greater contribution of additive genetic components in the inheritance of these attributes. The heritable variation can be found with the help of heritability estimates and genetic gain; the present investigation heritability could be estimated in only broad sense. Although high heritability denotes high proportion of genetic effects in the determination of these characters and can be adopted for improving yield per ha (q). Yield per ha (q) character showing high heritability, could be owing to greater contribution of additive genetic components in the inheritance of these attributes. Similar results also found earlier by Mallor et al., (2011), Singh et al., (2013), Singh et al., (2020) and Kumar et al., (2020) in various crops.

Mean Performance

As per (Table 3) there is a vast difference for the 9 characters among the 10 genotypes of Onion. Agri-found Light Red had highest mean performance for the different characters such as Number of Leaves /plant (6.26), Height of the Plant (cm) (29.03) and Leaf Length (cm) (27.15) these are significantly differed with the other varieties. NHRDF Red 4 showed best result for Bulb Diameter (cm) (53.50). NHRDF Red-3 (L-652) found superior for four characters such as Fresh bulb Weight (gm) (116.00), Dry bulb weight (gm) (94.70), Yield per Plot (kg) (18.99) and Yield per Ha (q) (320.55). This may be due to better adaptations of environmental conditions and respond to nutrient management and cultural practices. These findings found similar to earlier findings of Mudasir et al., (2013), Rivera et al., (2016), Kari et al., (2018) and Jakhwal et al., (2022).

Correlation Coefficient

A wide range of variation in quantitative characters provides the basis for selection in plant breeding programme. The knowledge of association among the characters is useful to the breeder for improving the efficiency of selection. Correlation coefficient analysis measures the mutual relationship between plant characters and determines the component character on which selection can be made for genetic improvement of yield. Investigation regarding the presence of component and nature of association among

Table:1 Analysis of Variation for 9 Characters of Onion (*Allium cepa* L.)

Source of Variation	D.F.	Number of Leaves / plants	Height of Plant(cm)	Leaf Length (cm)	Duration of crop (days)	Bulb Diameter (cm)	Fresh bulb Weight(gm)	Dry bulb weight (gm)	Yield per Plot(kg)	Yield per Ha (q)
Replication	2	0.01	0.02	0.01	23.07	0.01	3.29	1.98	0.06	52.94
Treatment	9	2.71	10.17	7.06	62.52	37.84	544.67	589.09	44.42	13274.57
Error	18	0.04	0.99	0.74	4.11	4.41	14.34	7.03	0.39	86.48
Total	29	0.86	3.77	2.65	23.54	14.48	178.17	187.32	14.03	4177.02

Table:2 Estimation of genetic variability of 10 genotypes for 9 characters of Onion (*Allium cepa* L.)

Characters	Mean	Min	Max	var (g)	var (p)	Heritability (%)	GA	GA% mean	GCV (%)	PCV (%)	ECV (%)
Number of Leaves /plants	5.30	2.76	6.26	0.89	0.93	95.93	1.90	35.93	17.81	18.18	3.67
Height of the Plant(cm)	25.52	22.83	29.03	3.06	4.05	75.59	3.13	12.28	6.86	7.89	3.90
Leaf Length (cm)	24.77	22.45	27.15	2.11	2.85	73.98	2.57	10.39	5.86	6.81	3.48
Duration of crop (days)	148.58	142.99	155.19	19.47	23.58	82.58	8.26	5.56	2.97	3.27	1.36
Bulb Diameter (cm)	48.61	44.00	53.52	11.14	15.55	71.66	5.82	11.98	6.87	8.11	4.32
Fresh bulb Weight (gm)	87.89	65.33	116.00	176.78	191.12	92.50	26.34	29.97	15.13	15.73	4.31
Dry bulb weight (gm)	66.66	42.60	94.70	194.02	201.05	96.51	28.19	42.29	20.90	21.27	3.98
Yield per Plot(kg)	13.93	8.27	18.99	14.68	15.07	97.41	7.79	55.91	27.50	27.86	4.49
Yield per Ha (q)	236.42	138.00	320.55	4396.03	4482.51	98.07	135.26	57.21	28.04	28.32	3.93

Table:3 Mean performance of 10 genotypes of Onion (*Allium cepa* L.) for 9 characters

SL	Genotypes	Number of Leaves / plants	Height of the Plant (cm)	Leaf Length (cm)	Duration of crop (days)	Bulb Diameter (cm)	Fresh bulb Weight (gm)	Dry bulb weight (gm)	Yield per Plot(kg)	Yield per Ha (q)
1	NHRDF Red (L-28)	5.79	27.20	25.31	150.40	53.30	80.26	60.57	16.00	281.10
2	NHRDF Red-3 (L-652)	5.56	26.29	26.20	150.95	51.50	116.00	94.70	18.99	320.55
3	NHRDF Red-4	5.81	26.95	26.75	145.49	53.52	88.80	68.38	18.30	309.75
4	Agri-found Light Red	6.26	29.03	27.15	142.99	46.75	96.44	76.25	18.21	312.75
5	Local Colletion-1	5.54	24.04	24.43	145.82	51.00	90.97	70.81	15.01	249.80
6	Local Collection-2	2.76	24.86	23.40	144.00	47.15	79.30	57.85	11.35	190.90
7	Local Collection-3	5.36	25.28	23.88	144.24	44.30	96.00	75.60	11.91	195.90
8	Local Collection-4	5.53	24.20	23.89	152.61	48.75	65.33	42.60	10.25	172.70
9	Local Collection-5	5.37	24.48	24.20	154.10	44.00	84.25	61.45	11.02	192.76
10	Local Collection-6	5.03	22.83	22.45	155.19	45.80	81.53	58.40	8.27	138.00
	Mean	**5.30**	**25.52**	**24.77**	**148.58**	**48.61**	**87.89**	**66.66**	**13.93**	**236.42**
	Min	**2.76**	**22.83**	**22.45**	**142.99**	**44.00**	**65.33**	**42.60**	**8.27**	**138.00**
	Max	**6.26**	**29.03**	**27.15**	**155.19**	**53.52**	**116.00**	**94.70**	**18.99**	**320.55**
	SE(d)	**0.16**	**0.81**	**0.70**	**1.66**	**1.71**	**3.09**	**2.16**	**0.51**	**7.59**
	C.D.	**0.34**	**1.72**	**1.49**	**3.50**	**3.63**	**6.55**	**4.58**	**1.08**	**16.08**
	C.V.	**3.67**	**3.90**	**3.48**	**1.36**	**4.32**	**4.31**	**3.98**	**4.49**	**3.93**

themselves is essential and prerequisite for improvement in yield. Correlation coefficient provides a clear picture of the extent of association between a pair of traits and indicates whether simultaneous improvement of the correlated traits may be possible or not. The knowledge of genetic association between yield and its component characters helps in improving the efficiency of selection for yield by making proper choice and balancing one component with another.

In present study correlation coefficient at both genotypic and phenotypic levels with the Yield per ha (q) and its component characters have been

Table:4. Phenotypic path with Seed Yield (q/ha) in 10 genotypes of Onion (*Allium cepa* L.) for 9 characters

Characters	Number of Leaves /plant	Height of the Plant(cm)	Leaf Length (cm)	Duration of crop (days)	Bulb Diameter (cm)	Fresh bulb Weight (gm)	Dry bulb weight (gm)	Yield per Plot(kg)	Yield per Ha (q)
Number of Leaves /plant	0.0487	0.0574	-0.0956	-0.0060	0.0278	0.0738	-0.0528	0.4056	0.459*
Height of the Plant(cm)	0.0184	0.1520	-0.1337	0.0367	0.0494	0.0922	-0.0739	0.6287	0.770**
Leaf Length (cm)	0.0257	0.1122	-0.1810	0.0272	0.0572	0.1406	-0.0932	0.7542	0.843**
Duration of crop (days)	0.0042	-0.0801	0.0708	-0.0697	-0.0086	-0.0587	0.0560	-0.3329	-0.419*
Bulb Diameter (cm)	0.0104	0.0573	-0.0791	0.0046	0.1309	0.0317	-0.0236	0.4907	0.623**
Fresh bulb Weight (gm)	0.0126	0.0493	-0.0894	0.0144	0.0146	0.2845	-0.1766	0.5234	0.633**
Dry bulb weight (gm)	0.0141	0.0617	-0.0928	0.0214	0.0170	0.2762	-0.1819	0.5588	0.675**
Yield per Plot(kg)	0.0235	0.1137	-0.1624	0.0276	0.0764	0.1772	-0.1210	0.8405	0.975**

Resi = 0.0254, *, ** significant at 5% and 1% level, respectively

Table:5. Genotypic path with Yield per Plot(kg) in 10 genotypes of Onion (*Allium cepa* L.) for 9 characters

Characters	Number of Leaves /plants	Height of the Plant(cm)	Leaf Length (cm)	Duration of crop (days)	Bulb Diameter (cm)	Fresh bulb Weight (gm)	Dry bulb weight (gm)	Yield per Plot(kg)	Yield per Ha (q)
Number of Leaves /plants	0.1196	0.1691	-0.3418	-0.0089	0.0555	0.0881	-0.0464	0.4574	0.493**
Height of the Plant(cm)	0.0553	0.3658	-0.5552	0.0327	0.0629	0.1409	-0.0766	0.8271	0.853**
Leaf Length (cm)	0.0738	0.3668	-0.5536	0.0265	0.1070	0.1726	-0.0960	0.7608	0.858**
Duration of crop (days)	0.0172	-0.1926	0.2362	-0.0622	-0.0209	-0.1011	0.0569	-0.4135	-0.480**
Bulb Diameter (cm)	0.0369	0.1279	-0.3291	0.0072	0.1799	0.0379	-0.0285	0.6599	0.692**
Fresh bulb Weight (gm)	0.0337	0.1647	-0.3055	0.0201	0.0218	0.3128	-0.1628	0.5823	0.667**
Dry bulb weight (gm)	0.0345	0.1740	-0.3300	0.0220	0.0319	0.3161	-0.1611	0.6189	0.706**
Yield per Plot(kg)	0.0593	0.1281	-0.5468	0.0279	0.1287	0.3776	-0.1081	0.9220	0.989**

Resi = 0.0078, *, ** significant at 5% and 1% level, respectively

Table:6 Phenotypic correlations in 10 genotypes of Onion (Allium cepa L.) for 9 characters

Characters	Number of Leaves / plants	Plant Height (cm)	Leaf Length (cm)	Duration of crop (days)	Bulb Diameter (cm)	Fresh bulb Weight (gm)	Dry bulb weight (gm)	Yield per Plot (kg)	Yield per Ha (q)
Number of Leaves /plants	1.000	0.378*	0.528**	0.087	0.213	0.259	0.290	0.459*	0.483**
Height of the Plant(cm)			0.739**	-0.527**	0.377*	0.324	0.406*	0.770**	0.748**
Leaf Length (cm)				-0.391*	0.437*	0.494**	0.512**	0.843**	0.897**
Duration of crop (days)					-0.066	-0.206	-0.308	-0.419*	-0.396*
Bulb Diameter (cm)						0.111	0.130	0.623**	0.584**
Fresh bulb Weight (gm)							0.971**	0.633**	0.623**
Dry bulb weight (gm)								0.675**	0.665**
Yield per Plot(kg)									0.975**
Yield per Ha (q)									1.000

*, ** significant at 5% and 1% level, respectively

Table 7: Genotypic correlations in 10 genotypes of Onion (Allium cepa L.) for 9 characters

Characters	Number of Leaves / plants	Plant Height (cm)	Leaf Length (cm)	Duration of crop (days)	Bulb Diameter (cm)	Fresh bulb Weight (gm)	Dry bulb weight (gm)	Yield per Plot(kg)	Yield per Ha (q)
Number of Leaves /plants	1.000	0.462*	0.617**	0.144	0.309	0.281	0.288	0.493**	0.496**
Height of the Plant(cm)			0.812**	-0.527**	0.350	0.450*	0.476**	0.853**	0.897**
Leaf Length (cm)				-0.427*	0.595**	0.552**	0.596**	0.858**	0.988**
Duration of crop (days)					-0.116	-0.323	-0.353	-0.480**	-0.448*
Bulb Diameter (cm)						0.121	0.177	0.692**	0.716**
Fresh bulb Weight (gm)							0.982**	0.667**	0.632**
Dry bulb weight (gm)								0.706**	0.671**
Yield per Plot(kg)									0.989**
Yield per Ha (q)									1.000

*, ** significant at 5% and 1% level, respectively

worked out. In general; the genotypic correlation coefficient values were higher than phenotypic correlation coefficient values. This indicated that strong intrinsic associations were somewhat masked at phenotypic level due to environmental effects. Yield per (q) hectare expressed highly significant and positive correlation with seed yield per plot (kg) viz. leaf length (cm), Height of the plant (cm), bulb diameter (cm), Dry bulb weight (gm),Fresh bulb weight(gm),No. of leaf per plant, where as duration of crop so negative and significant correlation These findings found were similar to earlier findings of Raghuwanshi et al.,(2016), Machado et al.,(2017), Segundo et al., (2022), in their investigation. The strains with high yields will be identified through selection based on any one of these traits, either individually or in combination. Therefore, it can be concluded that strains with high yields will be identified through selection based on any one of these traits, either individually or in combination.

Direct And Indirect Effect

The genotypic direct as well as indirect effects were slightly higher in magnitude as compared to corresponding phenotypic direct and indirect effects. The high and positive direct effect on Yield per ha (q), was observed for yield per plot per (kg), Height of the plant (cm),Fresh bulb Wight (gm), bulb diameter(cm) and No. of leaf plant observed very high which indicates that these characters play the significant role to increase the yield per ha(q) .High but negative direct effect exhibited by leaf length ,dry bulb weight and Duration of crop(days) on yield kg per ha (q) at genotypic level, therefore these characters may be selected for onion crop improvement. At the phenotypic level, also the estimates of direct and indirect were generally similar to those exhibited by genotypic level with little variation in magnitude. The magnitude of residual effects at both phenotypic and genotypic level was observed to be low. These results are in agreement with these findings found similar to earlier findings of Solanki et al., (2015) and Tomar et al.,(2022) .

CONCLUSION

Mean performance values showed that all the characters have significant difference for all the nine characters of ten genotypes of Onion. As the value of mean performance changes, it may lay direct impact on yield per ha (q) and yield will also change. Phenotypic coefficient of variance (PCV) was higher than the genotypic coefficient (GCV) of variation for all traits indicating that environmental factor influencing their expression and their susceptibility to environmental fluctuations. Variability studies suggest that all the characters revealed that direct selection is more effective to improve all the character Agri-found Light Red had highest mean performance for the different characters such as Number of Leaves / plants, Height of the Plant (cm), and Leaf Length (cm) these are significantly differed with the other varieties. Whereas Local Collection-6 found best performer for Duration of crop (days) and Number of branches per plant (3.80). NHRDF Red showed best result for Bulb Diameter (cm) . NHRDF Red-3 (L-652) found best for four characters such as Fresh bulb Weight (gm), Dry bulb weight (gm)

,Yield per Plot (kg) and Yield per Ha (q) in Onion and these verities may be choose for further crop improvement program in Onion crops.

REFERENCES

[1.] Goncalves, L. S., Rodrigues, R., Amaral, A. T. Jr., and Karasawa, M. (2008).Comparison of multivariate statistical algorithms to cluster Tomato heirloom accessions. Genetics and Molecular Research, 7: 1289-1297.

[2.] Jakhwal R, Goswami G, Pant S.C., Kumar V, Bahuguna P and Verma S. (2022) Genetic Divergence Studies in Radish (Raphanus Sativus L.) Under Hilly Region of Bharsar (Uttarakhand) In India. Annals of Horticulture 15 (1): 98-101

[3.] Kari.Ä, L., & Golzardi, M. (2018). Genetic diversity assessment of Allium cepa L. cultivars from Bosnia and Herzegovina using SSR makers. Genetics and Molecular Research, 17(1): 162-170.

[4.] Kumar Vipin, Taru Dumi, Arvind Kumar, Archi Gupta and Uttam Kumar (2020).Variability, Heritability and Genetic Advance for Yield And Yield Related Traits In Tomato (Solanum lycopersicum). Annals of Horticulture 13 (1): 61-65.

[5.] Lush, J. L. (1949). Heritability of quantitative characters in farm animals. Heretics Suppl, 356-357.

[6.] Lynch, M. and Walsh, J. B. (1998). Genetics and analysis of quantitative traits. Sinaure Assocs. Inc., Sunderland, Massachusetts, USA, 980p.

[7.] Machado, D. L. M., de Freitas, J. A., Luz, J. M. Q., Maciel, G. M., Nogueira, A. P. O., & di Camillo, E. (2017). Phenotypic, genotypic, and environmental correlations between characters in onion segregate populations obtained under different generations. Genetics and Molecular Research, 16(4): 1-7.

[8.] Mallor Giménez, C., Carravedo Fantova, M., Estopañán Muñoz, G., & Mallor Giménez, F. (2011). Characterization of genetic resources of onion (Allium cepa L.) from the Spanish secondary centre of diversity. Spanish Journal of Agricultural Research, 9 (1): 144-155.

[9.] Mudasir, A., Nusrat, J., & Asima, A. (2013). Determination of genetic diversity in onion (Allium cepa L.) by multivariate analysis under long day conditions. African Journal of Agricultural Research, 8(45): 5599-5606.

[10.] Porta, B., Rivas, M., Gutiérrez, L., & Galván, G. A. (2014).Variability, heritability, and correlations of agronomic traits in an onion landrace and derived S1 lines. Crop Breeding and Applied Biotechnology, 14: 29-35.

[11.] Raghuwanshi, O. S., Jain, P. K., Sengupta, S. K., Dangi, A. S., Verma, N. R., & Sunil, P. (2016). Correlation and path analysis study in diverse onion (Allium cepa L.) genotypes. Asian Journal of Horticulture, 11(1): 19-24.

[12.] Rivera, A., Mallor, C., Garcés-Claver, A., García-Ulloa, A., Pomar, F., & Silvar, C. (2016). Assessing the genetic diversity in onion (Allium cepa L.) landraces from northwest Spain and comparison with the European variability. New Zealand Journal of Crop and Horticultural Science, 44(2): 103-120.

[13.] Segundo, V. C. V., Innecco, R., Freitas, J. A., Lima, E. N., Nogueira, A. P. O., LUZ, J., & QUEIROZ, M. (2022). Genetic Parameters and Diversity, and Correlations in Onion Strains. Revista Caatinga, 35: 352-362.

[14.] Singh, S. R., Ahamed, N., Srivastava, K. K., Kumar, D., & Yousuf, S. (2020). Assessment of genetic divergence in long day onion (Allium cepa L.) through principal component and single linkage cluster analysis. Journal of Horticultural Sciences, 15(1): 17-26.

[15.] Solanki, P., Jain, P. K., Prajapati, S., Raghuwanshi, N., Khandait, R. N., & Patel, S. (2015). Genetic analysis and character association in different genotypes of onion (Allium cepa L.). International Journal of Agriculture, Environment and Biotechnology, 8(4): 783-789.

[16.] Steel, R. G. D. and Torrie, J. H. (1980). Principles and procedures of statistics. A biometrical Approach. 2nd Ed. McGraw Hill Book Co., New York.

[17.] Tomar H., Kumar V., Singh S., Kumar R and Kumar A.(2022) Genetic Variability, Heritability, Correlation and Path Coefficient Analysis in Amaranth (Amaranthus spp.) in Western Uttar Pradesh (India) International Journal of Environment and Climate Change 12(11): 1780-1791.