ISSN:0971-1260
Vol-22-Issue-34-December -2019

Genetic relatedness of the mineral profile and other selected components in indigenous cultivars of onion (*Allium cepa* L.)

Yudhvir Singh[1], Vishalakshi[1], Bhallan Singh Sekhon[1,2] and Sonia Sood[1]

[1,2]Department of Horticulture, School of Agricultural Sciences, Lovely Professional University, Phagwara, Punjab, India
[1]Department of Vegetable Science & Floriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh, 176062, India.
Corresponding author: bhallansekhon3249@gmail.com; +917832848550

Abstract

In the era of malnutrition and hidden hunger, improvement of mineral profile along with the important quality and horticultural traits is the need of the hour. However, very little/ negligible research has been carried out to suggest the selection indices with respect to simultaneous improvement of mineral traitsalong with yield for onion improvement. Therefore, the present investigation was carried out to study thegenetic relatedness of the mineral profile and other selected components in indigenous cultivars of onion (Allium cepa L.). Fifty eight indigenous cultivars were taken up for study. Analysis of variance revealed significant differences among the genotypes for all the recorded traits except moisture content (%). High GCV and PCV along with high heritability and genetic advance was observed for pyruvic acid, iron content, average bulb weight and marketable yield suggesting the role of additive gene action, thus selection for these traits in early generations would be effective. Values of phosphorus and iron content ranged from 22.05 to 33.67 mg/ 100g per cent and 0.28 to 0.67 mg/ 100g respectively, indicating the diverse mineral profile of the studied material. Average bulb weight and total yield could be suggested as best selection indices for onion improvement on the basis of correlation and path analysis. Changes in the iron content correlates positively with the marketable yield at both the genotypic and phenotypic levels. In addition, high direct effects of iron pave the way to incorporate it as a selection parameter for improving the mineral profile along with horticultural traits in indigenous onion cultivars.Further, wide variability for pyruvic acid content could be explored by involving the best performing indigenous cultivars in hybridization programmes.

Keywords: *correlation, marketable yield, onion, pyruvic acid, variability*

Introduction

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Onion (*Allium cepa* L.) is one of the most expensive vegetable and had influence on nation's economy. Its daily consumption as ingredient with other vegetables in the form of salads, spices, condiment further increased its popularity worldwide. Moreover, increasing demand of onion in processing industries particularly related to paste and pickles as well as in dehydration industry is the another reason for price hike. Medicinal properties like reduction in occurrence of chronic diseases (Insani et al. 2016), cancers (Sengupta et al. 2004) and cardiovascular diseases (Banerjee and Maulik 2002). Koch and Lawson (1996) also described the use of onion for pneumonia treatment and healing putrid wounds (Koch and Lawson 1996).

Thiosulfinates like allicin are measured indirectly through the estimation of pungency level in Alliums (Sance et al. 2006). Further, the correlation of pyruvic acid content with pungency level has been observed (Gallina et al. 2012). Disintegration of onion tissue by comminution may express pyruvic acid enzymatically (Schwimmer and Weston 1961). Identifying varieties having reduced pungency is the need of the hour.International consumers particularly of Japanese and European countries prefer these cultivars for fresh as well as uncooked consumption.

Conversely, countries falling in the region of Middle East and Gulf, Malaysia, Singapore, Sri Lanka, Bangladesh, Pakistan and Nepal prefer onions pungent in flavour. Moisture content has both merits and demerits. On one hand, appropriate moisture content is beneficial as it imparts crispness to the onions to be eaten raw. The study of ash content is very important to the extent that it provides an insight into the nutritionally important inorganic mineral elements.

Phosphorus and calcium are placed first, if one attempts to rank them on the basis of most abundant minerals in *Allium* species (Akinwande and Olatunde 2015). Besides, iron, an essential micronutrient needed by plant in smaller quantities, is also considered of enormous importance. Phosphorus works as "*hitting two birds with a single stone*" by acting both as major (essential) nutrient and as a catalyst in key biochemical reactions. It also plays an important role in stimulated root development, uniform and earlier crop maturity, improved flower formation and seed production, improves the crop quality and imparts resistance to plant diseases. Calcium, in the form of calcium pectate, is responsible for holding together the cell walls of plants. Calcium is also used in activating certain enzymes and to send signals that coordinate certain cellular activities. Plants only need a tiny amount of iron to be healthy, but that small amount is

ISSN:0971-1260
Vol-22-Issue-34-December -2019

crucial.Synthesis of DNA, photosynthesis, chlorophyll synthesis as well as respiratory processes, all needs iron for their proper functioning.

Among quality parameters, a total soluble solid (TSS) is an important biochemical trait which directly influencethe flavour and nutrition in onion and has immense importance in processing industry. High TSS values effects texture, storability and the quality of fruits on positive side.Ascorbic acid (AA), potential antioxidant and a major metabolite in plants acts as protective cover against stresses caused by drought and harmful UV radiations. Besides, AA also provides resistance against pest and diseases by enhancing the activity of enzymes like peroxidase and polyphenol oxidase.

Onion being cash crop, not only fetches high income per unit area of land but also has immense export potential. Substantial work has been reported for the development of breeding technologies, especially the improved cultivars/ hybrids with elevated yields in the past era. Important selection indices for yield improvement through yield related traits were also suggested by numerous researchers. However, very little attempts have been made to assess the simultaneous improvement of mineral and quality traits, through the genetic relatedness studies. Keeping this in view, the present research was formulated to study the variability, correlation and path analysis among selected mineral and other yield components in indigenous cultivars of onion (*Allium cepa* L.).

Materials and Methods

Location, Material, Year and Design of Study: The present investigation was undertaken at Vegetable Research Farm, CSK HPKV, Palampur on 58 indigenous cultivars of onion following randomized complete block design with three replications during *rabi* 2016-17.

Cultural Practices followed: The nursery beds were dug and prepared thoroughly, by removing all other undesirable materials from the beds. The nursery beds were prepared 1 m wide and 3 m long and elevated up to 15 cm from ground levels. The seeds were sown on 15th of October. The seeds were treated with Bavistin (3g/kg of seed) and were sown in nursery. Sprinkling of water with water cans was done immediately. This practice was repeated frequently as and when required to make the beds well moisturized till the germination. After germination of seeds, cover of the dry straw was removed. Weeding was done manually as and when weeds appeared in the nursery beds without disturbing the seedling. After 30 DAS, the seedlings were applied

ISSN:0971-1260
Vol-22-Issue-34-December -2019

5% of urea @ 10 days interval for proper growth of the seedlings. The nursery beds were also sprayed with DM-45 @ 2.5% at 10-15 days interval. The experimental area was ploughed, harrowed and finally prepared with rotavator in order to bring the soil in well pulverized condition. Plots of size 1.5m×2.0m ($3m^2$) were made according to the layout plan after levelling.

Eight week old healthy seedlings were transplanted on 15^{th} of December, 2016. Seedlings were uprooted from the nursery bed and transplanted in the plots at a spacing of 15 cm (row to row) and 10 cm (plant to plant). Transplanting was done in the afternoon or evening hours immediately followed by sprinkler irrigation for proper establishment of the seedlings. A week after transplanting, gap filling was done.

Farm yard manure @ 25 t/ha incorporated at last ploughing of the field. Nitrogen was applied in three splits in the form of urea. Basal dose of N @ 40 kg/ha was given at transplanting to all the treatments uniformly. Second and third doses of N @ 30 kg/ha were applied at 30 and 60 days after transplanting. Phosphorus and Potassium were applied through Single Super Phosphate and Muriate of Potash @ 75 kg and 50 kg/ha respectively as a basal dose to all treatments uniformly at the time of transplanting. Plant protection measures were taken up to maintain the crop in healthy condition.Light irrigation was given just after transplanting and subsequent irrigation was given as and when required depends upon soil type and climatic conditions. Weeds were removed timely by hand weeding so that there was no competition for growth in between the crop and weeds. Weeding was done by khurpi in such a way that soil was also loosened to provide proper aeration for crop growth. Likewise three weedings were done during the crop growth i.e. 30, 60 and 90 days after transplanting.

Parameters recorded: Data were recorded five horticultural traits viz., equatorial diameter (cm), polar diameter(cm), average bulb weight (g), total yield (kg/plot) and marketable yield (Kg/plot) along with nine quality traits *viz.,* total soluble solids (°Brix), vitamin C (/100 mg); pyruvic Acid (μ mol/g), moisture content (%), ash content (%), phosphorus (mg/100g), calcium (mg/100g) and Iron content (mg/100g).

Quantitation of selected quality parameters and minerals: Total soluble solids of represented samples of mature bulbs were estimated by ERMA hand refractometer. Ascorbic acid content was estimated from the marketable bulbs by following method as given by Ranganna (1977). Slight modification in Schwimmer and Weston (1961) was done as per (Anthon and Barrett, 2003) for estimation of pyruvic acid. The moisture content of powdered onion sample was

ISSN:0971-1260
Vol-22-Issue-34-December -2019

determined in an oven through drying method according to the procedure described by Dantata and Oseni (2009). Determination of the multi-elements (calcium, magnesium and iron) was done according to the method of Zarcinas et al. (1987).

Statistical Analysis: Analysis of variance was carried out on given parameters as per Panse and Sukhatme (1954). Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were analysed following the procedure of Burton (1952). Method suggested by Hanson et al. (1956) was used to compute heritability and genetic advance. Correlation coefficient and path analysis was done as per methods suggested by Johnson et al. (1955) and Dewey and Lu (1959), respectively. For convenience, following classifications were used for describing various parameters in the text.

Parameters	High	Medium	Low
PCV and GCV	>20 %	10 – 20 %	<10 %
Heritability in bs	>60 %	30 – 60 %	<30 %
Genetic advance	>30 %	10 – 30 %	<10 %

Result and discussion

Significant difference was observed for all the traits studied except moisture content (%) indicating the presence of sufficient genetic variability among the germplasm. The variation in the performance of 58 genotypes for different traits ranged for TSS (°Brix) (8.67-12.36), ascorbic acid (mg/100 g) (6.38-11.89), pyruvic acid (μ mol/g) (2.35-11.56), moisture content (%) (80.67-88.07), ash content (%) (0.17-0.40), phosphorus (mg/100g) (22.05-33.67), calcium (mg/100g) (18.34-25.84), iron (mg/100g) (0.28-0.67), average bulb weight (g) (26.45-72.09), polar diameter (cm) (3.41-7.69), equatorial diameter (cm) (3.33-7.84), total bulb yield (kg/ plot) (5.29-14.42) and marketable yield (kg/plot) (4.13-14.42), indicating the wide range of variation in the studied material for most of the traits studies. Significant differences in the performance of different genotypes in their respective genetic material was observed for TSS (Singh et al. 2017; Sahu et al. 2018), ascorbic acid content (Jurgiel et al. 2015; Liguori et al. 2017), pyruvic acid (Liguori et al. 2017; Santraet al. 2017),moisture content(Sharma et al. 2017), ash content, phosphorus, calcium and iron(Akinwande and Olatunde 2015), polar diameter (Santraet al. 2017; Sahu et al. 2018), equatorial diameter (Sharma et al. 2017; Singh et al. 2017), average bulb

ISSN:0971-1260
Vol-22-Issue-34-December -2019

weight (Chattoo et al. 2015; Santraet al. 2017)., total yield (Sharma et al. 2017; Singh et al. 2017) and marketable yield (Richa and Akhilesh 2016; Santraet al. 2017).

The estimates of genetic parameters of variability *viz*., phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV)along with heritability (h^2) in broad sense and genetic advance (GA) as per cent of mean for different traits are given in Table 1. The PCV was higher than GCV indicating the role of environment. Singh et al. (2017) and Jat and Vikram (2018) also found high PCV than the corresponding GCV in their respective studies.High GCV and PCV values were observed for pyruvic acid, iron content, average bulb weight and marketable yield indicating high variability in the germplasm for these traits (Table 1) while these values were moderate for both polar and equatorial diameter, and low for TSS and moisture content. Further, PCV values alone were high for Vitamin C, Ash content and total yield, and moderate for phosphorus and calcium. GCV values were moderate for Vitamin C, Ash content and total yield while these values were low for phosphorus and calcium. Heritability and genetic advance were observed to higher for pyruvic acid, iron content, average bulb weight and marketable yield. Further, High heritability estimates were observed for all the traits except calcium (moderate) and moisture content (low). Total soluble solids, phosphorus and calcium showed moderate values for genetic advance while these values were low for moisture content. On the whole, high values of GCV, PCV, heritability along with high genetic advance for pyruvic acid, iron content, average bulb weight and marketable yield indicated the role of additive genes. Thus it would be effective to do selection in early generations.

Earlier research workers have also revealed high PCV and GCV in their respective studies by using different breeding material for average bulb weight, total bulb yield (Dewangan and Sahu 2014), iron content (Saini 2011) and marketable bulb yield (Dewangan and Sahu 2014).Contrary to low estimates for TSS in our study, moderate PCV and GCV estimates havebeen reported by earlier research workers for total soluble solids (Hosamani et al. 2010; Singh et al. 2010).High heritability estimates in their respective studies by using different breeding material for average bulb weight (Dewangan and Sahu 2014), marketable bulb yield and total bulb yield (Dewangan and Sahu 2014; Solanki et al. 2015), polar diameter, equatorial diameter, total soluble solids and pyruvic acid in bulbs (Santraet al. 2017). High values for heritability as well as genetic advance were also observed for total bulb yield (Kushal et al.

ISSN:0971-1260
Vol-22-Issue-34-December -2019

2016), marketable yield (Yaso 2007), polar diameter (Khosa and Dhatt 2013), equatorial diameter (Khosa and Dhatt 2013) and average bulb weight (Chattoo et al. 2015).

Marketable yield had positive correlation with iron content, polar diameter, equatorial diameter, average bulb weight and total yield at both phenotypic and genotypic levels. Further, it had positive correlation with moisture content and total soluble solids, and negative with vitamin C content at genotypic level. Vitamin C showed positive correlation with pyruvic acid and negative correlation with equatorial diameter at both the levels. Besides it had positive correlation with moisture content and was negatively correlated with phosphorus at genotypic level. Pyruvic acid showed negative correlation with equatorial diameter at both the levels while had positive correlation with moisture content at genotypic correlation only. Moisture content was positively correlated with ash content, polar diameter, equatorial diameter, average bulb yield and total yield and negatively correlated with phosphorus at genotypic level. Ash content had positive correlation with calcium but negatively correlated with iron content at both the levels, while had negative correlation with phosphorus and average pod weight at genotypic level only. Calcium was observed to be negatively correlated withiron content at both the levels. Iron content was positively correlated with total yield, equatorial diameter, polar diameter and average bulb weight; polar diameter with total yield, average bulb weight and equatorial diameter; equatorial diameter with total yield and average bulb weight.

Earlier reports have also indicated significant and positive association for yield with equatorial bulb diameter, polar bulb diameter and total soluble solids (Lakshmi 2015; Raghuwanshi et al. 2016; Ghodkeet al. 2018) while evaluating different breeding materials at respective locations. Therefore, for the improvement of yield these traits need to be given special focus. Positive genotypic correlation of average bulb weight with polar diameter and equatorial diameter at phenotypic and genotypic level is supported by the findings of Golani et al. (2006), Dewangan and Sahu (2014) and Chattoo et al. (2015).

On the basis of direct and indirect effects, it was observed that average bulb weight, total yield, total soluble solids, iron content, moisture content and equatorial diameter had high positive direct effects on marketable yield at phenotypic level. Also high direct effects were observed for average bulb weight, moisture content, total yield, iron content, equatorial diameter and total soluble solids at genotypic level. A high direct effect of total soluble solids along with

ISSN:0971-1260
Vol-22-Issue-34-December -2019

substantial indirect contribution of average bulb weight adds to its positive correlation with marketable yield at genotypic level. For moisture content at genotypic level and for iron content and total yield at both the levels, indirect contribution of average bulb weight adds to their directeffects, thus results in their positive correlation with marketable yield. Ash content had negative correlation with yield which could be attributed to the contribution of indirect effects of average bulb weight to its direct effects at genotypic level. Further, high positive indirect effects of average bulb weight and total yield negated the negative direct effects of polar diameter, results in the positive correlation with the yield. Equatorial diameter had positive correlation with yield at both the levels which was the result of indirect contribution via average bulb weight and total yield and its direct effect to some extent. High direct effects of average bulb weight along with some indirect contribution through total yield results in its positive correlation with yield.

Earlier reports of many research workers have also indicated maximum direct effect of average bulb weight (Chattoo et al. 2015 and Kale et al. 2015), equatorial diameter (Raghuwanshi et al. 2016 and Sahu et al. 2018) and TSS (Richa and Akhilesh 2016 and Raghuwanshi et al. 2016)on marketable yield.The residual effects being low at both phenotypic (0.0973) and genotypic level (0.0678) indicated the presence of sufficient number of traits in the study.

Conclusion

Average bulb weight and total yield could be suggested as best selection parametersin onion breeding on basis of correlation and path analysis. Changes in the iron content correlates positively with the marketable yield at both the genotypic and phenotypic levels. In addition, high direct effects of iron pave the way to incorporate it as a selection parameter for improving the mineral profile along with horticultural traits in indigenous onion cultivars. Further, wide variability for pyruvic acid content could be explored by involving the best performing indigenous cultivars in hybridization programmes.

References

Akinwande, B. A., &Olatunde, S. J. (2015). Comparative evaluation of the mineral profile and other selected components of onion and garlic. *International Food Research Journal*, *22*(1).

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Anthon, G. E., & Barrett, D. M. (2003). Modified method for the determination of pyruvic acid with dinitrophenylhydrazine in the assessment of onion pungency. *Journal of the Science of Food and Agriculture*, *83*(12), 1210-1213.

Banerjee, S. K., &Maulik, S. K. (2002). Effect of garlic on cardiovascular disorders: a review. *Nutrition journal*, *1*(1), 4.

Burton, G. W. (1952). Quantitative inheritance in grasses. *Pro VI Int Grassl Cong, 1952*, 277-283.

Chattoo, M. A., & Angrej, A. (2015). Genetic variability, interrelationship and path analysis for yield and yield related traits in onion (Allium cepa L.) under temperate condition in Kashmir valley. *Plant Archives*, *15*(2), 1161-1165.

Dantata, I. J., &Oseni, T. O. (2009). Growth, yield and fruit characteristics of tomato as affected by nitrogen. *Biological and Environmental Sciences Journal for the Tropics*, *6*, 43-46.

Dewangan, S. R., &Sahu, G. D. (2012). Genetic variability, correlation and path coefficient analysis of different Kharif onion genotypes in Chhattisgarh plains. *Indian Horticulture Journal*, *2*(1and2), 9-12.

Dewey, D. R., & Lu, K. (1959). A Correlation and Path-Coefficient Analysis of Components of Crested Wheatgrass Seed Production 1. *Agronomy journal*, *51*(9), 515-518.

Gallina, P. M., Cabassi, G., Maggioni, A., Natalini, A., & Ferrante, A. (2012). Changes in the pyruvic acid content correlates with phenotype traits in onion clones. *Australian Journal of Crop Science*, *6*(1), 36.

Ghodke, P. H., Gijare, U. M., Andhale, P. S., Salunkhe, V. N., Mahajan, V., Gupta, A. J., & Singh, M. (2018). Genetic diversity in onion by multivariate analysis under short day condition. *Int. J. Curr. Microbiol. Appl. Sci*, *7*, 2184-2194.

Golani, I. J., Vaddoria, M. A., Mehta, D. R., Naliyadhara, M. V., &Dobariya, K. L. (2006). Analysis of yield components in onion. *Indian Journal of Agricultural Research*, *40*(3), 224.

Hanson, C. H., Robinson, H. F., & Comstock, R. E. (1956). Biometrical Studies of Yield in Segregating Populations of Korean Lespedeza 1. *Agronomy journal*, *48*(6), 268-272.

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Hosamani, R. M., Patil, B. C., &Ajjappalavara, P. S. (2010). Genetic variability and character association studies in onion (*Allium cepa* L.). *Karnataka Journal of Agricultural Sciences*, *23*(2).

Insani, E. M., Cavagnaro, P. F., Salomón, V. M., Langman, L., Sance, M., Pazos, A. A., ... & Galmarini, C. R. (2016). Variation for Health-Enhancing Compounds and Traits in Onion (*Allium cepa* L.) Germplasm. *Food and Nutrition*, *7*, 577-591.

Jat, M. K., & Vikram, B. (2018). Studies of variability pattern in agro-morphological characters in the onion genotypes (*Allium cepa* L.) in Rabi season under Allahabad agro-climactic condition. *Journal of Pharmacognosy and Phytochemistry*, *7*(2), 2051-2054.

Johnson, H. W., Robinson, H. F., & Comstock, R. E. (1955). Estimates of genetic and environmental variability in soybeans 1. *Agronomy journal*, *47*(7), 314-318.

Jurgiel-Malecka, G., Gibczynska, M., &Nawrocka-Pezik, M. (2015). Comparison of chemical composition of selected cultivars of white, yellow and red onions. *Bulgarian Journal of Agricultural Science*, *21*(4), 736-741.

Kale, S. M., &Ajjappalavara, P. S. (2015). Varietal evaluation of some important nutritional constituents in onion (*Allium cepa* L.) genotypes. *Asian Journal of Horticulture*, *10*(2), 242-245.

Khosa, J. S., &Dhatt, A. S. (2013). Studies on genetic variability and heritability in bulb onion (*Allium cepa* L.) in North-Western plains of India. *Journal of Horticultural Sciences*, *8*(2), 255-258.

Koch, H. P., & Lawson, L. D. (1996). *Garlic: the science and therapeutic application of Allium sativum L. and related species*. Lippincott Williams & Wilkins.

Kushal., Patil, M.G., Patil, S.S., Pampanna, Y., & Kavita, K. (2016). Genetic variability, heritability and correlation studies in onion (*Allium cepa* L.) *Green Farming7*(2), 361-364.

Lakshmi, R. 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.

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Liguori, L., Califano, R., Albanese, D., Raimo, F., Crescitelli, A., & Di Matteo, M. (2017). Chemical composition and antioxidant properties of five white onion (*Allium cepa* L.) landraces. *Journal of Food Quality*, *2017*.

Panse, V. G., & Sukhatme, P. V. (1954). Statistical methods for agricultural workers. *Statistical methods for agricultural workers.*

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.

Ranganna, S. (1977). Manual of analysis of fruit and vegetable products.

Richa, P., & Akhilesh, T. (2016). Genetic variability and character association for yield and its component traits in kharif onion genotypes. *International Journal of Basic and Applied Agricultural Research*, *14*(1), 43-49.

Sahu K, Sharma PK, Dixit A and Nair, S.K., (2018)**.** Correlation and path coefficient analysis in *kharif* onion (*Allium cepa* L.) genotypes for Chhattisgarh plains. *International Journal of Current Microbiology and Applied Sciences*, *6*, 256-263.

Saini, M. C. (2011). *Genetic variability and character association in kharif onion (Allium cepa L.)* (Doctoral dissertation, MPUAT, Udaipur).

Sance, M.M., Bauza, M., Camargo, A.B., Gonzalez, R.E., & Soto, V.E. (2006). Evaluation of the Argentinean garlic germplasm in relation to its aptitude for the freeze drying process. *Molecular Medicinal Chemistry*,*10*, 33-34.

Santra, P., Manna, D., Sarkar, H. K., &Maity, T. K. (2017). Genetic variability, heritability and genetic advance in kharif onion (*Allium cepa* L.). *Journal of Crop and Weed*, *13*(1), 103-106.

Schwimmer, S., & Weston, W. J. (1961). Onion flavor and odor, enzymatic development of pyruvic acid in onion as a measure of pungency. *Journal of Agricultural and Food Chemistry*, *9*(4), 301-304.

Sengupta, A., Ghosh, S., & Bhattacharjee, S. (2004). *Allium* vegetables in cancer prevention: an overview. *Asian Pacific Journal of Cancer Prevention*, *5*(3), 237-245.

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Sharma, P.K., Singh, A., Duhan, D.S., Kishor, N. and Barar, N.S., (2017). Genetic variability, heritability and genetic advance in onion (*Allium cepa* var. *cepa* L.). *International Journal Pure and Applied Biosciensės5*(6), 740-743.

Singh, P., Soni, A. K., Diwaker, P., Meena, A. R., & Sharma, D. (2017). Genetic Variability Assessment in Onion (*Allium cepa* L.) Genotypes. *Int. J. of Chem. Stud*, *5*(5), 145-149.

Singh, R. K., Dubey, B. K., Bhonde, S. R., & Gupta, R. P. (2010). Estimates of genetic variability and correlation in red onion (*Allium cepa*) advance lines. *Indian Journal of Agricultural Sciences*, *80*(2), 160-163.

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.

Yaso, I. A. A. (2007). Performance and genetic parameters for six onion genotypes in Nubaria area. *Egyptian Journal of Plant Breeding*, *11*(3), 307-318.

Zarcinas, B. A., Cartwright, B., &Spouncer, L. R. (1987). Nitric acid digestion and multi- element analysis of plant material by inductively coupled plasma spectrometry. *Communications in Soil Science and Plant Analysis*, *18*(1), 131-146.

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Table 1 Overall mean, Standard error of mean (SE(m) ±),Coefficient of variation (CV) and critical difference (CD) of 58 onion genotypes for selected quality, mineral and horticultural traits in onion

Components	TSS	AA	PA	MC	AC	P	Ca	Iron	PD	ED	ABW	TY	MY
Mean	9.97	8.75	6.50	84.29	0.32	28.93	22.06	0.46	5.55	5.75	52.65	10.48	9.59
SE(m) ±	0.32	0.47	0.39	1.65	0.02	1.59	1.03	0.02	0.20	0.17	4.21	0.84	0.78
C.V. (per cent)	5.63	9.28	10.46	3.36	11.62	9.52	8.06	8.21	6.31	5.04	13.85	13.88	14.10
C.D. (P≤0.05)	0.92	1.33	1.11	NS	0.07	4.50	2.90	0.06	0.57	0.47	11.91	2.37	2.21

TSS: TSS (°Brix); VC: Vit C (/100 mg); PA: Pyruvic Acid (µ mol/g); MC: Moisture Content (%); AC: Ash Content (%); P: Phosphorus (mg/100g); Ca: Calcium (mg/100g); Iron (mg/100g); PD: Polar diameter(cm); ED: Equatorial Diameter (cm); ABW: Average bulb weight (g); TY: Total Yield (kg/plot); MY: Marketable yield (Kg/plot)

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Table 2Range and estimates of genetic parameters of onion genotypes

Characters	Range	SE (d)	GCV	PCV	h^2bs (%)	GA(% of means)
TSS	8.67-12.36	9.97 ± 0.46	7.28	9.21	62.58	11.87
VC	6.38-11.89	8.75 ± 0.66	17.84	20.11	78.70	32.60
PA	2.35-11.56	6.50 ± 0.67	36.73	38.84	89.43	71.54
MC	80.66-88.07	85.33 ± 2.34	0.81	3.45	5.43	0.39
AC	0.17-0.40	0.32 ± 0.04	18.14	22.66	64.07	29.91
P	22.04-33.67	28.93 ± 2.25	9.77	13.64	51.34	14.43
Ca	18.34-25.84	22.06 ± 1.45	7.41	10.95	45.82	10.33
Iron	0.28-0.67	0.46 ± 0.03	20.75	22.31	86.56	39.77
PD	3.41-7.93	5.55 ± 0.29	16.71	17.86	87.53	32.21
ED	3.33-7.84	5.75 ± 0.24	16.52	17.27	91.50	32.55
ABW	26.45-78.34	52.65 ± 5.95	20.29	24.56	68.21	34.52
TY	5.90-15.61	11.18 ± 1.19	19.00	23.05	67.95	32.26
MY	4.13-14.81	9.59 ± 1.10	24.04	27.87	74.40	42.71

TSS: TSS (°Brix); VC: Vit C (/100 mg); PA: Pyruvic Acid (µ mol/g); MC: Moisture Content (%); AC: Ash Content (%); P: Phosphorus (mg/100g); Ca: Calcium (mg/100g); Iron (mg/100g); PD: Polar diameter(cm); ED: Equatorial Diameter (cm); ABW: Average bulb weight (g); TY: Total Yield (kg/plot); MY: Marketable yield (Kg/plot); SE (D): Standard error of differences; GCV: Genotypic coefficient of variation; PCV: Phenotypic coefficient of variation; h^2bs (%): heritability in broad sense; GA: Genetic Advance

ISSN:0971-1260
Vol-22-Issue-34-December -2019

Table 3 Phenotypic and Genotypic correlation coefficients of different horticultural and quality traits in onion

Traits		VC	PA	MC	AC	P	Ca	Iron	PD	ED	ABW	TY	MY
TSS	P	0.051	-0.108	-0.102	0.006	-0.017	-0.039	-0.012	0.103	0.022	0.085	0.081	0.122
	G	0.047	-0.147	-0.148	-0.076	0.054	-0.025	-0.033	0.087	-0.013	0.114	0.107	0.171*
VC	P		0.207**	0.095	-0.068	-0.039	0.132	-0.099	-0.078	-0.255**	-0.133	-0.148	-0.142
	G		0.268**	0.295**	-0.090	-0.161*	0.115	-0.104	-0.134	-0.309**	-0.114	-0.137	-0.141
PA	P			-0.099	0.101	-0.080	0.043	0.092	-0.118	-0.175*	-0.117	-0.110	-0.135
	G			-0.469**	0.137	-0.126	0.117	0.090	-0.117	-0.185*	-0.102	-0.095	-0.126
MC	P				0.095	0.064	0.056	0.009	0.134	0.041	0.025	0.018	0.044
	G				0.194*	-0.150*	0.063	-0.029	0.417**	0.246**	0.663**	0.639**	0.701**
AC	P					-0.138	0.183*	-0.170*	-0.020	-0.070	-0.077	-0.065	-0.109
	G					-0.188*	0.363**	-0.222**	-0.056	-0.122	-0.163*	-0.149	-0.204**
P	P						-0.062	0.031	-0.053	0.003	0.029	0.019	-0.012
	G						-0.075	0.089	-0.064	0.033	0.037	0.020	-0.040
Ca	P							-0.157*	0.071	0.029	0.061	0.059	0.013
	G							-0.250**	0.100	0.042	0.083	0.081	0.019
Iron	P								0.229**	0.206**	0.191*	0.188*	0.279**
	G								0.269**	0.229**	0.267**	0.266**	0.369**
PD	P									0.811**	0.770**	0.771**	0.736**
	G									0.880**	1.033**	1.038**	0.940**
ED	P										0.720**	0.727**	0.694**
	G										0.923**	0.932**	0.845**
ABW	P											0.997**	0.941**
	G											0.997**	0.927**
TY	P												0.938**

ISSN:0971-1260
Vol-22-Issue-34-December -2019

G	0.922^{**}

TSS: TSS (°Brix); VC: Vit C (/100 mg); PA: Pyruvic Acid (µ mol/g); MC: Moisture Content (%); AC: Ash Content (%); P: Phosphorus (mg/100g); Ca: Calcium (mg/100g); Iron (mg/100g); PD: Polar diameter(cm); ED: Equatorial Diameter (cm); ABW: Average bulb weight (g); TY: Total Yield (kg/plot); MY: Marketable yield (Kg/plot)

Table 4 Path coefficient analysis of marketable bulb yield per plot at phenotypic (P) and genotypic (G) level in onion

		TSS	VC	PA	MC	AC	p	Ca	Iron	PD	ED	ABW	TY	r
TSS	P	**0.047**	0.000	0.003	-0.003	0.000	0.001	0.001	-0.001	-0.003	0.001	0.066	0.012	0.122
	G	**0.143**	-0.007	-0.012	-0.031	0.006	-0.008	-0.001	-0.006	-0.055	-0.001	**0.119**	0.022	0.171^{*}
VC	P	0.002	**-0.005**	-0.006	0.003	0.002	0.002	-0.003	-0.010	0.002	-0.006	-0.103	-0.022	-0.142
	G	0.007	**-0.146**	0.021	0.061	0.007	0.023	0.004	-0.018	0.084	-0.035	-0.119	-0.028	-0.141
PA	P	-0.005	-0.001	**-0.028**	-0.003	-0.003	0.004	-0.001	0.009	0.003	-0.004	-0.091	-0.016	-0.135
	G	-0.021	-0.039	**0.078**	-0.097	-0.011	0.018	0.004	0.015	0.073	-0.021	-0.107	-0.019	-0.126
MC	P	-0.005	0.000	0.003	**0.033**	-0.002	-0.003	-0.001	0.001	-0.004	0.001	0.019	0.003	0.044
	G	-0.021	-0.043	-0.037	**0.207**	-0.015	0.022	0.002	-0.005	-0.260	0.028	0.693	0.131	0.701^{**}
AC	P	0.000	0.000	-0.003	0.003	**-0.026**	0.007	-0.004	-0.017	0.001	-0.002	-0.059	-0.009	-0.109
	G	-0.011	0.013	0.011	0.040	**-0.078**	0.027	0.012	-0.037	0.035	-0.014	-0.171	-0.030	-0.204^{**}
P	P	-0.001	0.000	0.002	0.002	0.004	**-0.051**	0.001	0.003	0.001	0.000	0.022	0.003	-0.012
	G	0.008	0.024	-0.010	-0.031	0.015	**-0.144**	-0.002	0.015	0.040	0.004	0.039	0.004	-0.040
Ca	P	-0.002	-0.001	-0.001	0.002	-0.005	0.003	**-0.022**	-0.016	-0.002	0.001	0.047	0.009	0.013
	G	-0.004	-0.017	0.009	0.013	-0.028	0.011	**0.032**	-0.042	-0.063	0.005	0.086	0.017	0.019
Iron	P	-0.001	0.000	-0.003	0.000	0.004	-0.002	0.003	**0.102**	-0.006	0.005	0.148	0.027	0.279^{**}
	G	-0.005	0.015	0.007	-0.006	0.017	-0.013	-0.008	**0.169**	-0.168	0.026	0.279	0.055	0.369^{**}
PD	P	0.005	0.000	0.003	0.005	0.001	0.003	-0.002	0.023	**-0.027**	0.019	0.595	0.112	0.736^{**}
	G	0.012	0.020	-0.009	0.086	0.004	0.009	0.003	0.045	**-0.624**	0.101	1.080	0.212	0.940^{**}
ED	P	0.001	0.001	0.005	0.001	0.002	0.000	-0.001	0.021	-0.022	**0.023**	0.556	0.106	0.694^{**}

ISSN:0971-1260
Vol-22-Issue-34-December -2019

	G	-0.002	0.045	-0.015	0.051	0.010	-0.005	0.001	0.039	-0.550	**0.114**	0.965	0.191	0.845**
ABW	P	0.004	0.001	0.003	0.001	0.002	-0.001	-0.001	0.019	-0.021	0.017	**0.772**	0.145	0.941**
	G	0.016	0.017	-0.008	0.137	0.013	-0.005	0.003	0.045	-0.645	0.106	**1.045**	0.204	0.927**
TY	P	0.004	0.001	0.003	0.001	0.002	-0.001	-0.001	0.019	-0.021	0.017	0.770	**0.146**	0.938**
	G	0.015	0.020	-0.007	0.132	0.012	-0.003	0.003	0.045	-0.648	0.107	1.042	**0.205**	0.922**

Unexplained variation (P): 0.0973; (G): 0.0678; *Significant at P≤0.05; r-correlation coefficient with marketable yield; bold values indicate direct effectsTSS: TSS (°Brix); VC: Vit C (/100 mg); PA: Pyruvic Acid (μ mol/g); MC: Moisture Content (%); AC: Ash Content (%); P: Phosphorus (mg/100g); Ca: Calcium (mg/100g); Iron (mg/100g); PD: Polar diameter(cm); ED: Equatorial Diameter (cm); ABW: Average bulb weight (g); TY: Total Yield (kg/plot); MY: Marketable yield (Kg/plot)

ISSN:0971-1260
Vol-22-Issue-34-December -2019

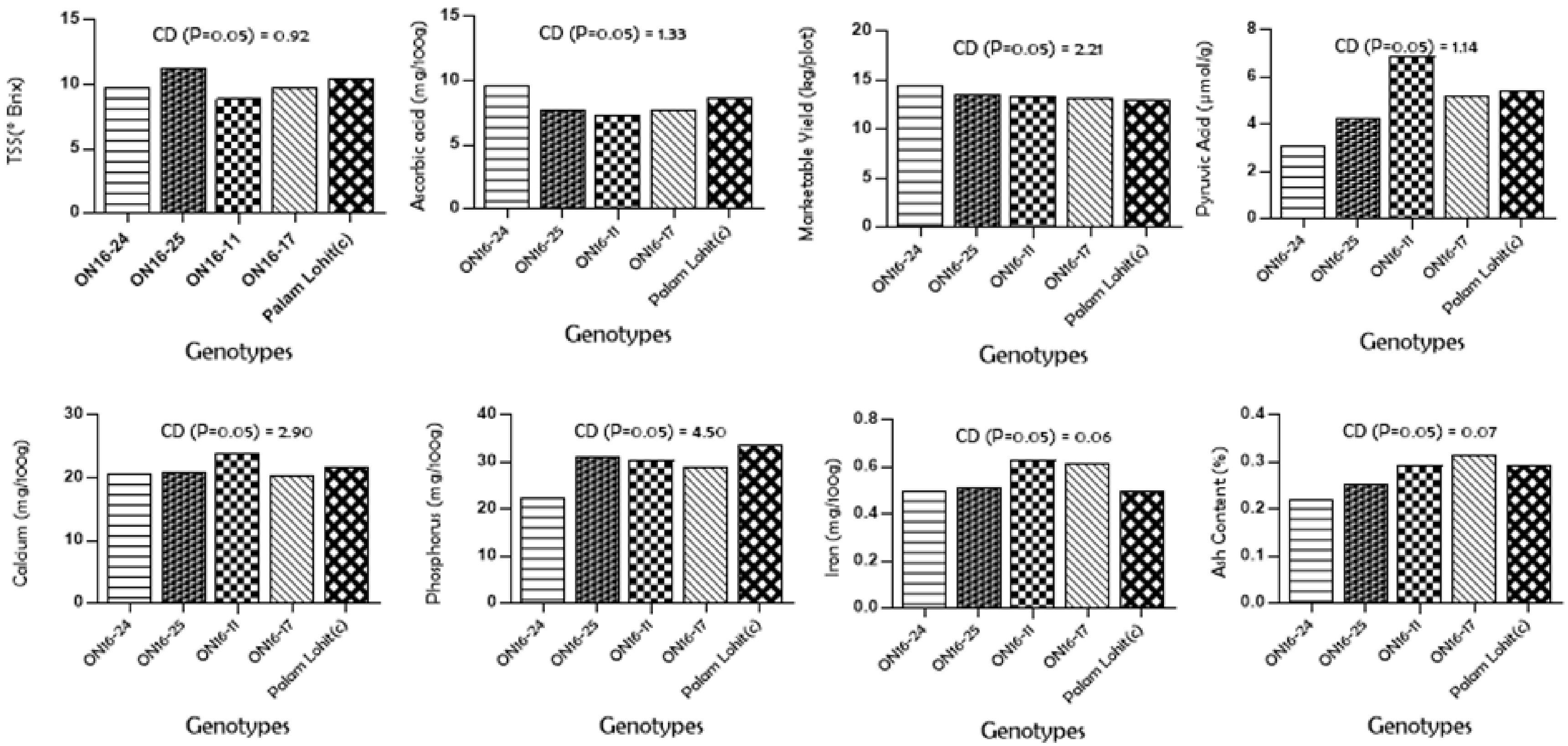

Fig 1. Mineral profile and quality composition of best performing genotypes for yield in onion