

**EVALUATION OF ORANGE FLESHED SWEET  
POTATO (*Ipomoea batatas* L.) GENOTYPES**

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**NOVEMBER, 2021**

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POTATO (*Ipomoea batatas* L.) GENOTYPES**

*Thesis submitted to the  
University of Horticultural Sciences, Bagalkote  
in partial fulfillment of the requirements for the  
award of degree of*

**Master of Science (Horticulture)**

*in*

**VEGETABLE SCIENCE**

**BY**

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**CERTIFICATE**

This is to certify that the thesis entitled "**EVALUATION OF ORANGE FLESHED SWEET POTATO (*Ipomoea batatas* L.) GENOTYPES**" submitted by **MISS PALLAVI WANI, ID No. UHS19PGM1174** for the degree of **MASTER OF SCIENCE (HORTICULTURE) in VEGETABLE SCIENCE** to the University of Horticultural Sciences, Bagalkote is a record of research work done by her study at University of Horticultural Sciences, Bagalkote under my guidance, supervision and the thesis has not previously been formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

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## ACKNOWLEDGEMENT

*This is the time to look back the path I traversed and to acknowledge the magnanimous personalities who helped me and rendered their precious time for me during my course of study.*

*With immense pleasure and deep respect, I express my heartfelt thanks, gratitude and appreciation to my chairman of the Advisory Committee, **Dr. Ambresh**, Assistant Professor (Vegetable Science) for his critical evaluation of the manuscript and his kind, ever helpful personality and ceaseless encouragement throughout the period of this endeavor. His judicious guidance, innovative ideas, valuable suggestions, and constant encouragement is duly acknowledged in scripting this holograph.*

*I avail this opportunity to express my deep sense of relevance and gratitude to the members of my advisory committee, **Dr. C. N. Hanchinmani** Professor and Head (Vegetable science) COH, Bangalore, **Dr. Shantappa T N** Professor and Head, ADRE, RHREC, Dharwad, **Dr. Arunkumar Bhavidoddi** Assistant Professor (Vegetable Science) ICAR-AICRP on vegetable crops, RHREC Dharwad, **Dr. Suvarna Patil** Assistant Professor, (Entamology), RHREC, Kumbapur, Dharwad for their valuable suggestions and support provided in conducting my experiment.*

*My special thanks to **Dr. Vilas Gasti**, Professor and Head, Department of Vegetable Science, KRCCCH Arabhavi, for constant source of inspiration and time taken out of his busy schedule to appreciate and support my work as best way as possible.*

*I owe this pride place to my dearest parents, **Mr. Sangappa Wani** and **Mrs. Nirmala Wani**, my beloved brother **Rohit Wani**, grandparents and family members for their blessings and affectionate love which brings out the best in every one of my endeavors.*

*I am grateful to my senior friends Ravi, Sharavati, Anusha, Prutivi, Gayitri, Sulochana, for their timely help, care and everlasting support which helped me in successful completion of research and thesis work.*

*I feel immense pleasure and joy in expressing my profound affection and gratitude to my friends Priyanka, Aishwarya, Pallavi, Manjunath, Kumar, Basvant, Nagavinayak for their care, precious help, constant support, and encouragement which is always remembered. From the depth of my heart. I wish to thank my junior friends*

*Revati, Satish, Vidya, Pratik, for their affection, care and unforgettable help.*

*I extend my sincere thanks to the Department of Vegetable Science, Kitur Rani Chennamm College of Horticulture, Arabhavi, UHS, Bagalkote for giving me an opportunity to complete my higher education M. Sc. (Horticulture) in Vegetable Science.*

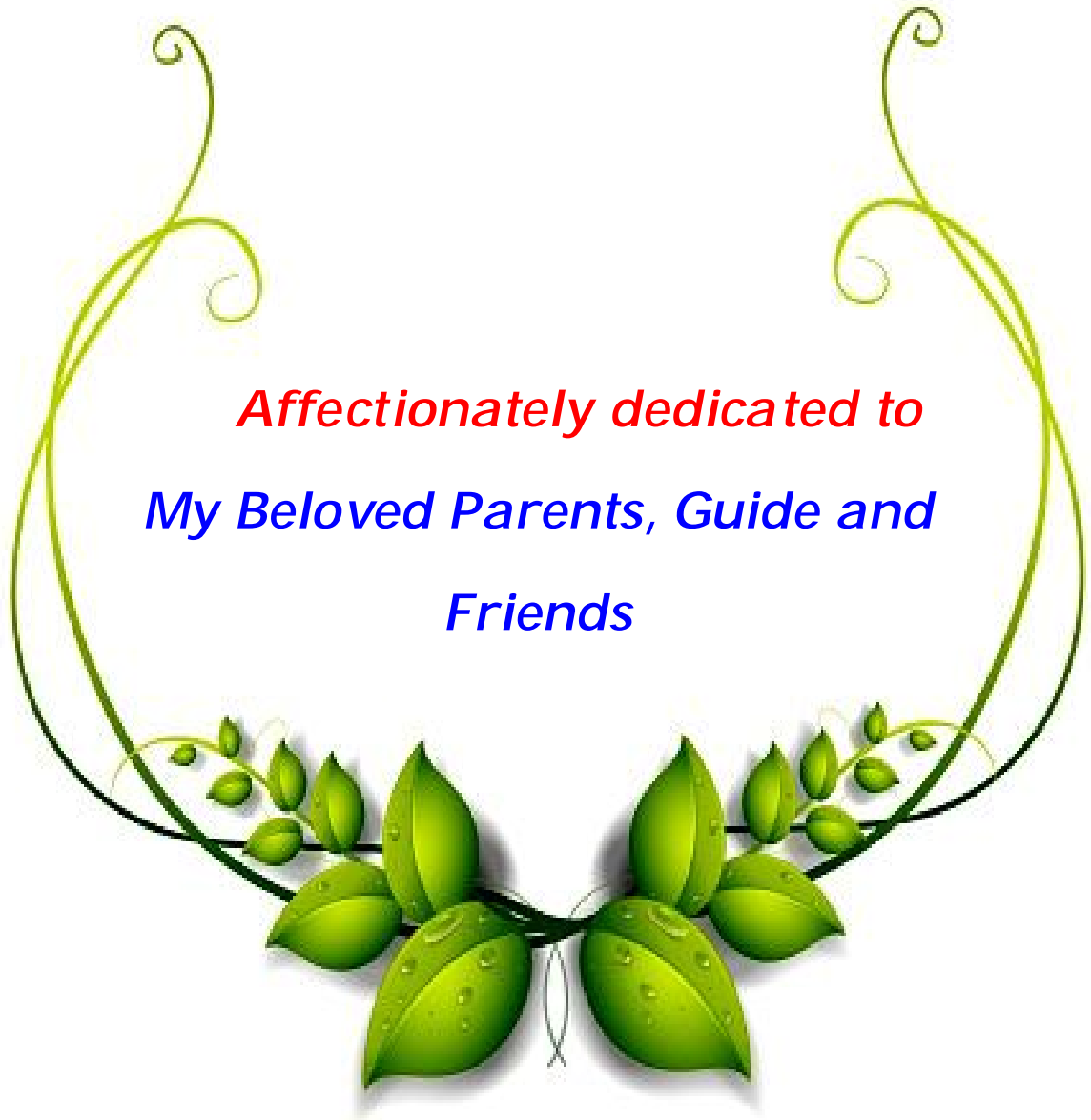
*I am thankful to the staff and field workers of RHREC, Kumbapur, Dharwad, for their constant support and help during the course of my research work.*

*I am thankful to Mr. Kalmesh of “Kalmesh Computers, Dharwad” for their co-operation during preparation of this manuscript. End is inevitable for any kind of work. Though acknowledging is an endless task, I end by saying infinite thanks to all those whom I am able to recall here and also to those whom I might have left unknowingly.*

**ARABHAVI  
NOVEMBER, 2021**

**(PALLAVIWANI)**

*Affectionately dedicated to*  
*My Beloved Parents, Guide and*  
*Friends*



## CONTENTS

Sl. No.	Chapter Particulars	Page No.
	CERTIFICATE	iii
	ACKNOWLEDGEMENT	iv
	LIST OF ABBREVIATIONS	ix
	LIST OF TABLES	x
	LIST OF FIGURES	xi
	LIST OF PLATES	xii
	LIST OF APPENDICES	xiii
<b>1.</b>	<b>INTRODUCTION</b>	<b>1-4</b>
<b>2.</b>	<b>REVIEW OF LITERATURE</b>	<b>5-36</b>
	2.1 Genetic variability, heritability and genetic advance	5
	2.2 Correlation coefficient studies	17
	2.3 Path coefficient analysis	24
	2.4 Post harvest studies and Quality parameters	31
<b>3.</b>	<b>MATERIAL AND METHODS</b>	<b>37-52</b>
	3.1 Geographical location of experimental site	37
	3.2 Weather conditions of the experimental site	37
	3.3 Experimental details	37
	3.4 Cultural operations	39
	3.5 Observations recorded on growth, yield and quality attributes	41
	3.6 Statistical analysis of experimental data	46
<b>4.</b>	<b>EXPERIMENTAL RESULTS</b>	<b>53-88</b>
	4.1 Analysis of variance	53
	4.2 Mean performance of genotypes	56
	4.3 Genetic variability, heritability and genetic advance for growth, yield and quality parameters	69
	4.4 Correlation coefficient studies	77
	4.5 Path coefficient analysis	82

<b>5.</b>	<b>DISCUSSION</b>	<b>89-100</b>
	5.1 Genetic variability, heritability and genetic advance for growth, yield and quality parameters	89
	5.2 Correlation coefficient studies	94
	5.3 Path coefficient analysis	97
	5.4 Quality Parameter and weevil infestation	98
<b>6.</b>	<b>SUMMARY AND CONCLUSIONS</b>	<b>101-104</b>
	<b>REFERENCES</b>	<b>105-122</b>
	<b>APPENDICES</b>	<b>123</b>

## LIST OF ABBREVIATIONS

Sl. No.	Abbreviations	
1	%	Per cent
2	AICRP	All India Co-ordinated Research Project
3	Anon	Anonymous
4	C.D	Critical difference
5	cm	Centimetre
6	cm <sup>2</sup>	Centimeter square
7	DAP	Days after planting
8	DAS	Days after storage
9	<i>et al.</i>	Others/co-workers/associates
10	fig.	Figure
11	g	Grams
12	GA	Genetic advance
13	GAM	Genetic advance over mean
14	GCV	Genotypic coefficient of variation
15	h <sup>2</sup>	Heritability
16	ha	Hectare
17	<i>i.e.</i>	That is
18	kg	Kilogram
19	m	Meter
20	m.MT	Million metric tones
21	PCV	Phenotypic coefficient of variation
22	rG	Genotypic correlation
23	rP	Phenotypic correlation
24	S.Em	Standard error of the means
25	t	Tonnes
26	TSP	Tuber Sweet Potato
27	<i>viz.</i>	Namely

## LIST OF TABLES

Table No.	Title	Page No.
1	List of genotypes used for the study with their salient features	40
2	Analysis of variance (mean squares) for growth parameters in orange fleshed sweet potato genotypes	54
3	Analysis of variance for yield and quality parameters in orange fleshed sweet potato genotypes	55
4	Mean Performance of orange fleshed sweet potato genotypes for growth parameters	57
5	Mean Performance of orange fleshed sweet potato genotypes for yield parameters	60
6	Tuber damage (%) by sweet potato weevil infestation	63
7	Mean Performance of orange fleshed sweet potato genotypes for quality parameters	64
8	Mean Performance of orange fleshed sweet potato genotypes for physiological loss of weight	66
9	Effect of ambient storage on Tuber appearance (Scores) of different orange fleshed sweet potato genotypes	67
10	Effect of storage on flesh color and skin color in tubers of different orange fleshed sweet potato genotypes	68
11	Estimates of mean, range and genetic parameters for growth attributes in orange fleshed sweet potato genotypes	70
12	Estimates of mean, range and genetic parameters for yield and quality attributes in orange fleshed sweet potato genotypes	75
13	Genotypic correlation coefficients among growth and yield parameters in orange fleshed sweet potato genotypes	78
14	Phenotypic correlation coefficients among growth and yield parameters in orange fleshed sweet potato genotypes	81
15	Genotypic path coefficient analysis among growth and yield parameters in orange fleshed sweet potato genotypes	84
16	Phenotypic path coefficient analysis among growth and yield parameters in orange fleshed sweet potato genotypes	87

## LIST OF FIGURES

Figure No.	Title	Between Page
1	Plan and layout of the experimental plot	38-39
2	GCV, PCV, heritability and genetic advance as per cent of mean for growth parameters in orange fleshed sweet potato genotypes	92-93
3	GCV, PCV, heritability and genetic advance as per cent of mean for yield parameters in orange fleshed sweet potato genotypes	92-93
4	GCV, PCV, heritability and genetic advance as per cent of mean for quality parameters in orange fleshed sweet potato genotypes	92-93
5	Genotypic path coefficient analysis of growth and yield parameters in orange fleshed sweet potato genotypes	94-95
6	Physiological loss of weight during storage in different genotypes of orange fleshed sweet potato	98-99

**LIST OF PLATES**

<b>Plate No.</b>	<b>Title</b>	<b>Between Page</b>
1.	General view of the experimental plot	38-39
2.	Variability for tuber characters in sweet potato	74-75

**LIST OF APPENDICES**

<b>Appendix No.</b>	<b>Title</b>	<b>Page No.</b>
I.	Meteorological data recorded during experimental period at RHREC, Kumbapur (Dharwad), UHS, Bagalkote during 2020- 21	123

# 1. INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) in the world it is ranked seventh most important food crops. It belongs to the family convolvulaceae, is one of the most important tuber crops of tropical and sub-tropical regions of the world. Sweet potato is considered to be native of South America. About 80 per cent of the world sweet potato is grown in Asia, 15 per cent in Africa and about 5 per cent in rest of the world. In India, sweet potato rank third position next to potato and cassava among the major tuber crops in terms of area and production. In India it is grown in an area of 0.13 million ha and produces 1.5 m.MT with a productivity of 11.5 MT/ha (NHB, 2018). In India, it is mainly cultivated in Bihar, Orissa, Uttar Pradesh, Madhya Pradesh, Maharashtra and Karnataka. Sweet potato mainly grown in Orissa which is leading in area and production. Whereas, productivity is highest in Andhra Pradesh. In Karnataka sweet potato grown an area of about 2.71 thousand hectares with production of 34.80 thousand MT and productivity of 12.84 t/ha (NHB, 2018).

The sweet potato constitutes the staple diet of tribal population due to hardiness and adaptability into diversify farming system. Sweet potato is used both for direct human consumption and manufacturing of industrial products such as starch, glucose pectin, sugar and alcohol *etc.* Carbohydrates (starches and simple sugars), protein and fat are the major nutritional value lies in sweet potato tubers (Allen *et al.*, 2012). Sweet potato tubers have anti-diabetic, anti-oxidant and anti-proliferative properties due to the presence of valuable nutritional (low glycaemic index) and mineral components *viz.*, phosphorus, calcium, magnesium and sodium (Jaarsveld *et al.*, 2005).

Sweet potato is an important raw material to produce different products such as noodles, vermicelli, soluble and refined starch and alcohol drinks. Orange fleshed sweet potatoes (OFSP) are very nutritious, being an excellent source of  $\beta$ -carotene and vitamin C. It is grown more in developing countries than any other crop. Sweet potato account for 98 per cent of the world's production in developing countries. Due to its wider adaptability on marginal land and nutritional rich content has the potential to combat malnutrition and increase food security in the developing world. The storage roots also contain vitamins C, B complex and E as well as potassium, calcium and iron. The skin colour ranges between red, purple, brown and white. Its flesh colour ranges from white through yellow, orange and purple. Sweet potato varieties with dark orange flesh have more  $\beta$ -carotene than those with light colored flesh (Mitra, 2012).

The amount of variability that is present in the genetic material of any crop is very important for breeding of elite varieties. Genetic variation for any character is a basic requirement for its improvement by use of systematic breeding activities. Sweet potato is highly cross-pollinated crop hence, it shows continuous variation for many of its traits. Since, Sweet potato is highly heterozygous in state, so there is a presence of substantial amount of variability within the species, which is available to the plant breeders for its exploitation (Jones *et al.*, 1986). So that it is most important to consider quantitative approaches for utilization of the large-scale genetic variability accessible in sweet potato, mean while which is dependent on assessment of the genetic parameters. The amount of variability for a particular trait is a basic requirement for its improvement, hence estimates of genetic parameters will be a basic tool for selection of elite genotypes and it also aids in hybridization programme.

Sweet potato is considered as the one of the appreciated crop producing the highest root dry matter content for human consumption. 70 per cent of the dry weight of sweet potato is constituted by the starch content and high dry matter content as a significant characteristic of a good sweet potato variety. Tubers with high starch content are important characteristics desired by the sweet potato industry. Its processing cost is decrease due to the absence of oxidation reactions, high starch and low soluble sugar contents. Now the crop is directed as an important source for biofuel production because of its ability to carry high amount of starch biomass which can be fermented and converted into ethanol.

The area and production of sweet potato in the state is very low as compared to national level which is due to unavailability of suitable variety with wider adaptability and stability of the variety. Although, it is an important tuber crop in India, but very little awareness has been given so far on its improvement. For crop improvement programme, genetic variability is very important to know the inheritance pattern of the characters. Studies on the spectrum of variability regards of its commercial value are necessary to obtain the knowledge of inheritance pattern (Jones, 1986).

Looking to the above facts, the present investigation was undertaken with the following objectives.

### **Objectives of investigation**

1. To study the variability in orange fleshed sweet potato genotypes for yield and yield attributing traits.

2. To study the character association and path analysis among yield and yield attributing traits of orange fleshed sweet potato genotypes.
3. To study quality attributes and post harvest traits of orange flesh sweet potato genotypes.

## 2. REVIEW OF LITERATURE

Sweet potato is a crop having a wide range of variability in tuber yield potentiality, tuber skin and flesh color, tuber appearance and time of maturity, leaf shape, flowering habit and several other morphological characters which can be used for the development of elite genotypes. The information on both quantitative and qualitative characters are helpful for the selecting superior sweet potato genotypes. The knowledge of total genotypic variance (GV) in a plant population is of great importance to the breeder to control over the variance for the improvement of the characters. Due to lack of information on above aspects in sweet potato, the literature related to other tuber crops *viz.*, potato, cassava, taro, elephant foot yam, *etc.* are cited in this chapter. Therefore, an effort has been made to review the information available in the literature pertaining to the present study under the following sub headings.

- 2.1 Genetic variability, genetic advance and heritability for growth, yield and quality of tubers
- 2.2 Correlation coefficient studies
- 2.3 Path coefficient analysis
- 2.4 Post harvest studies and quality parameters

### **2.1 Genetic variability, genetic advance and heritability for growth, yield and tuber quality**

In every breeding program information regarding the environment and degree of variability and association of plant characters are advantageous as a source for selection of desired parents. In crop improvement program, the information on the degree of variability present in quantitative character is of great importance as the success of phenotypic selection depends upon the range of genetic variability present in the population. When existing variability in the chosen material is wide it is effective for developing better-quality genotypes. The variability for any character is the result of the interaction of hereditary effects of concerned genes and the influence of environment. It is necessary to partition total phenotypic variability into heritable and non-heritable

components to have an effective selection for superior genotypes. Estimation of the coefficient of variation helps to assess variability in the population. Heritable variation can be effectively used with a greater degree of accuracy when heritability is studied in conjunction with genetic advance (GA). A wide range of variability in terms of range, genotypic and phenotypic coefficient of variations (GCV and PCV), heritability ( $h^2$ ) in a broad sense and genetic advance (GA) for various growth, yield and quality parameters have been reported by several workers. Hence, an attempt has been made to accumulate back ground information on the total amount of genetic variability present in the sweet potato genotypes.

Kumar *et al.* (1996) conducted research on twenty-five genotypes of sweet potato grown in Ranchi, during *kharif* revealed that vine length, number of branches, number of leaves and tuber yield showed high genotypic and phenotypic coefficients of variation whereas genotypic coefficient of variability ranged from 11.12 per cent (length of tuber) to 39.07 per cent (number of branches). They also recorded high estimates of heritability for vine length (96.05 %), leaves number (90.3 %), number of branches (90.0 %) and tuber yield (75.9 %) and comparatively low for number of tubers (45.5 %). Number of tubers, tuber width and tuber weight showed high genetic association with yield.

Alam *et al.* (1998) studied fifteen genotypes of sweet potato and observed that the higher genotypic and phenotypic coefficients of variation were recorded for a number of branches, number of tubers per plant, total yield per plant, number of leaves per plant and vine length. They also said that high estimates of heritability coupled with high or moderate estimates of genetic advances were recorded for all the characters except tuber length.

An experiment was conducted on nine clones of sweet potato on the basis of variation in quantitative characters during 90, 105 and 120 days after planting by (Velmurugan *et al.*, 1999) and the result showed that clones with high number of tubers per vine gave higher mean value for tuber yield and highest variability was observed for weight of weevil-free tubers followed by weight of tubers per vine and number of weevil-free tubers per vine.

The maximum variability for the weight of weevil-free tubers per vine, weight of tuber per vine, number of weevil-free tuber per vine, harvest index and number of tubers per vine was observed by (Velmurugan *et al.*, 2000).

The high heritability coupled with high estimates of genetic advance (GA) for vine length, number of leaves and yield of tuber per plant was observed in sweet potato (Rao *et al.*, 2003).

The genotype IB-90-15-9 showed maximum total soluble solid for Chhattisgarh plains was reported in sweet potato (Sahu 2003).

Sharma (2004) studied on open pollinated seedlings population of sweet potato [*Ipomoea batatas* (L.) Lam.]. Reported that the higher genetic coefficient of variation for marketable tuber yield.

An experiment was conducted on genetic variability for eight parameters in eighty-six genotypes of sweet potato [*Ipomoea batatas* (L.) Lam.] of diverse origin. High heritability estimates were noticed for vine traits *viz.*, vine length and number of branches per plant. The least estimate of heritability was observed for a number of tubers per plant. The characters such as single tuber weight, number of branches per plant, tuber girth and length of tuber showed high estimates of heritability coupled with high genetic advance indicating the presence of additive gene effect (Teshome *et al.*, 2004).

An experiment was conducted to investigate phenotypic and genotypic variances and coefficient of variation in 100 accessions of potato by Basavaraj *et al.* (2005). Analysis of variance indicating the presence of sufficient genetic variation among the genotypes. The phenotypic coefficient of variation ranged from 25.33 for plant height to 77.09 for tuber yield per plant. Similarly, the genotypic coefficient of variation ranged from 10.60 for a number of stems per plant to 48.41 for tuber yield. The results revealed that plant height, number of tubers per plant, tuber weight per plant, tuber yield per plant exhibited moderate to higher phenotypic and genotypic coefficient of variation.

Joseph *et al.* (2005) evaluated a set of seventeen potato genotypes and reported that sufficient variation was present for all characters except for number of leaves and tuber dry matter. Heritability values were moderate to high for all characters except for

the number of leaves at all the locations and for plant height and number of shoots at Kufri.

The moderate to high phenotypic as well as the genotypic coefficient of variation was registered for almost all the characters except for per cent emergence was reported by Regassa and Basavaraj (2005). High heritability coupled with higher genetic advance as per cent of the mean was noticed for most of the characters except for non-reducing sugar and per cent emergence at 30 days after planting.

The wide range of variability in vine traits (32.4 to 82.5 %) and in root traits (43.04 to 76.81 %) of sweet potato and the high genotypic coefficients of variation coupled with high heritability and possible genetic advance (GA) were noted for vine length, leaf area, vine internodal length, above ground fresh weight and dry weight, number of storage root per plant, individual storage root fresh yield per plant and storage root weight per plant (Engida *et al.*, 2006).

Mishra *et al.* (2006) revealed that the traits *viz.*, stolon length, plant height, leaf area, number of shoots per plant, tuber volume, dry matter content of tuber, tubers specific gravity, shoot girth and yield of tuber per plant had high genotypic coefficient of variation, heritability and genetic advance as per cent of mean.

Gasura *et al.* (2008) studied preliminary genetic analysis for yield and quality following crossing elite 7 female and 6 male cultivars in a North Carolina showed wide genetic variability in the F<sub>1</sub>'s for the important traits and heterosis was observed for few traits such as tuber size and number of tubers per plant.

An experiment on 30 genotypes of sweet potatoes by Gin *et al.* (2008) reported that GCV was highest for vine growth rate (65.3%) followed by vine internodal length (61.64%), number of tubers per plant (44.87%), tuber weight per plant (43.72%), petiole length (35.85%), single tuber weight (28.73%), length of tuber (26.69%) and tuber diameter (20.26%).

Shashikanth *et al.* (2008) conducted a study on fifteen sweet potato genotypes and observed that the phenotypic and genotypic coefficient of variation were found to be moderate to high for all the characters *viz.*, internodal length, number of branches per plant, number of leaves, total leaf area except vine length. They also observed that the

high heritability with high genetic advance as percent over mean for all the traits except leaf area.

Evaluation of forty-four genotypes for thirteen characters reported by Barik *et al.* (2009) who revealed that marketable yield, total yield of tuber and tubers number per plant had higher phenotypic and genotypic coefficient of variation, whereas the moderate range of GCV and PCV was observed for fresh weight of shoots per plant, per cent emergence and plant height.

Mondal *et al.* (2009) evaluated thirty-one genotypes of potato in order to find out the genetic variability of tuber yield and its component characters. All the genotypes showed highly significant variation for all the characters studied and revealed that heritability was found high for plant height, number of tubers per plant and tuber weight per plant, individual tuber weight per plant and tuber weight loss percentage at 150 days after harvest.

Kaledzi *et al.* (2010) studied on 40 accessions of sweet potato and observed variations among the different accessions in terms of the vine, leaf, petiole and root skin and flesh characteristics.

Afuape *et al.* (2011) observed the canonical variety analysis and showed that variation among the traits occurred mostly between groups than within-groups and that it was largely influenced by total root weight, weight of marketable roots, number of marketable roots and total number of roots.

Paul and Bari (2011) reported the wide range of variability existed among the accession as well as local cultivars of edible aroid. Genotypic variance and coefficient of variation for most of the characters were remarkably higher than their corresponding environmental variance.

An experiment on sweet potato genotypes on the basis of leaf, vine and tuber characters was conducted by Wadud *et al.* (2011) and reported that leaf character varied from heart, tetralobbed to pentalobbed, the vine and vine tip colour ranged from green, pink, pinkish green, light purple, deep purple to light pink and the shapes of tuber were globose, elliptical and fusiform.

Richardson (2012) evaluated six genotypes of sweet potato for tuber quality and reported that the large deviation showed in the leaf and tuber characteristics.

Boakye *et al.* (2013) observed the extent of genetic variability, broad-sense heritability and correlations for fresh root weight, root number and top weight of five cassava genotypes across three locations in two years. Combined analysis of variance revealed highly significant genotypic effect for all the traits. High broad sense heritability coupled with genetic advance as per cent of the mean was observed for fresh root weight.

Genetic variability of cassava progenies studied by Manu-Aduening *et al.* (2013) and reported that the genotypes differed significantly ( $P < 0.001$ ) for the entire traits evaluated, cultivars such as Afebankye, Bosomnsia, Cedi bankye, 262 Debor, Kwadaso 25, Nkaakom 57 and Sisipe were found to constitute a pool of germplasm with adequate variability. The negative correlation between Cassava mosaic disease (CMD) incidence and other traits showed considerable improvement made in the breeding programme.

Mau *et al.* (2013) reported that LB-01 (4.15 kg/plant) clone recorded highest mean tuber yield whereas, ON-06 and LB-01 were most stable clones for tuber yield and yield components across diverse environments.

An experiment conducted on twenty-two genotypes of sweet potato by Thiyagu *et al.* (2013). Result revealed that high genotypic coefficients of variation coupled with high heritability were reported for petiole length and leaf area.

Amare *et al.* (2014) evaluated sweet potato (*Ipomoea batatas*) varieties for total storage root yield and reported that the superior mean total root yield (26.82 t/ha) was obtained at Kukufto testing location while the inferior (13.45 t/ha) was at Rarhe. Similarly, among the genotypes, LO shows the highest mean total root yield (30.9 t/ha), while Bellela gave the lowest (7.78 t/ha). The analysis for the total storage root yield by AMMI also showed the highly significant difference for genotypes, locations and interaction components.

Nasiruddin *et al.* (2014) conducted study on genetic diversity of thirty one genotypes of potato. The results concluded that plant height, number of leaflets per compound leaf, leaf area, foliage coverage per plant, fresh weight per compound leaf,

number of tuber per plant and tuber weight per plant exhibited high GA, high heritability coupled with higher GAM. Therefore, these traits might be suggested to improve the tuber yield by effective selection.

Values of broad-sense heritability for some quantitative characters in a potato population comprising 21 genotypes were reported during the 2013 and 2014. Based on the combined analysis of variance performed over two years, moderate to high level heritability values were found for plant height (0.77 cm), leaf width (0.69 cm), leaf length (0.71 cm), single tuber weight (0.74 gm), plant yield (0.60 gm) and starch content (0.87 %) (Ozturk and Yildirim, 2014).

Evaluation of 116 accessions of sweet potato for agronomic and physicochemical properties by Ali *et al.* (2015) who revealed that Tis-9465-7 had highest marketable tuber yield and fresh weight of the plant. CN-1752-14 had the highest reducing sugars while CN-1752-15 recorded highest total starch and total sugar content whereas, Korojo had the highest dry matter content.

Avijala *et al.* (2015) conducted a study on genetic variability in 31 cassava genotypes and reported that the coefficient of genetic variation ranged from 8.86 to 54.74 per cent and the highest CV values were for shoot biomass weight (54.74 %) and average number of roots per plant (47.71 %). The ratio of genetic and environmental coefficients of variation were higher than 1 for 6 of the 8 evaluated traits. These same traits presented high values for heritability, indicating that most of the observed variation is of genetic nature.

Genetic variability study in sweet potato (*Ipomoea batatas* L.) genotypes was carried out by Madawal *et al.* (2015). The results revealed that high heritability coupled with high Genetic advance as per cent mean were recorded for leaf area index, vine length, number of tubers per vine, length of tuber, tuber yield per plot, total soluble solids and tuber yield per hectare which indicates the presence of additive gene effects for these traits. Hence improvement can be done through phenotypic selection. High heritability with low to reasonable Genetic advance as per cent of mean was observed for internodal length, number of auxiliary branches and tuber girth which indicates the role of non-additive gene effects.

Mbah and Eke-Okoro (2015) studied the relationship between some growth parameters, dry Matter content and yield of some sweet potato genotypes grown under rainfed weathered ultisols in the humid tropics. The results revealed that Umuspo 1 (31.2 t/ha), closely followed by TIS 87/0087 (27.45 t/ha) significantly gave the maximum storage root yield compared to the other genotypes and also exhibited highest Total Dry Matter yield (TDM) (71.99 g plant G1), Crop Growth Rate (CGR), Relative Growth Rate (RGR) and Absolute Growth Rate (AGR).

The study was conducted to investigate the genetic variability of thirty genotypes of sweet potato (Prarthana *et al.*, 2015). The result proved that vine length, vine internodal length, number of branches per plant, number of leaves per plant, total leaf area, root yield per plant, beta carotene content, starch content, total sugars, reducing and non reducing sugars and root yield per hectare (t/ha) exhibited high PCV, GCV and high heritability coupled with expected genetic advance (GA).

An experiment conducted on variability for yield and yield related attributes traits of 33 genotypes of sweet potato reported by Singh *et al.* (2015). The outcome of results proved that the high magnitude of the phenotypic coefficient of variation was observed for leaves per vine followed by the vine length, internodal length and branches per vine and tubers per vine. Phenotypic coefficient of variation was higher than genotypic coefficient of variation. Higher value of heritability coupled with high genetic advance (GA) observed for vine length, internodal length, number of branches per vine, mean weight of tuber and width of leaves.

Studies on heritability, genetic advance in per cent of mean for yield and yield attributing characters in Taro (*Colocasia esculenta* var. *antiquorum*) germplasm indicated that corm yield per plant, starch content, petiole length, cormel yield per plant, sheathe length, number of cormels per plant and width of lamina exhibited high value of PCV and GCV (Singh *et al.*, 2015).

Asefa *et al.* (2016) assessed the nature and extent of variability for yield of tuber and late blight resistance characters. The high genotypic (GCV) and phenotypic (PCV) coefficient of variation computed which ranged from 22.7 to 51.9 per cent and 32.8 to

56.7 per cent, respectively. They revealed that the presence of considerable variability in tested genotypes for economically important traits and the higher chance of selecting genotypes with high yield and moderately resistant to late blight.

Genetic variability of sweet potato on yield and yield contributing traits reported by Demelie and Aragao (2016). The analysis of variance revealed that significant variation was observed for all traits except stand count at sprout which showed no significant difference among sweet potato genotypes. Genotypes showed total tuber yield ranged from 123.67 to 370.04 with a mean of 231.04 quintals per hectare while root weight 100 to 263 with an average mean of 168.04 grams. Genotypic coefficient of variation lower in magnitude than the phenotypic coefficient of variation for all agromorphological traits. Genotypic coefficient of variation ranged from 0.77 (stand count at sprout) to 33.93 (unmarketable tuber yield) while phenotypic coefficient variation ranged between 3.47 (stand count at sprout) to 39.36 (unmarketable tuber yield). Heritability in a broad sense was recorded for twelve traits ranged between 4.99 per cent (stand count at sprout) to 86.45 per cent (vine internodal length). Genetic advance as percent mean ranges from 7.42 per cent (stand count at harvest) to 60.27 per cent (unmarketable tuber yield).

A Study conducted by Mukherjee *et al.* (2016) on genetic variability for morphological and yield attributing characters of taro. The dry matter percentage was recorded highest genotypic (47.91%) and phenotypic (95.78%) co-efficient of variation, whereas tuber yield per plant showed the widest range (819.37). Number of cormels per plant and dry matter percentage exhibited considerably higher heritability (84.90 and 91.70%, respectively) and genetic advance (81.19 % and 79.00%, respectively), indicating the potentiality of selection for improvement of such characters.

The research was conducted to estimates of phenotypic and genotypic variance (GV) of potato genotypes by Tripura *et al.* (2016). Experiment result revealed that, variance were found to be high for the mean weight of tuber per plant, tuber number, tuber breadth and single tuber mass and comparatively high in plant height at 60 days after planting. The magnitude of PCV was either substantially or marginally higher than GCV for most of the traits.

Tripathi (2016) conducted research on twenty nine genotypes of sweet potato [*Ipomoea batatas* (L.) Lam] and observed that the higher phenotypic and genotypic coefficients of variation were recorded for a traits such as leaf area followed by yield per plant and leaves per vine. They also said that high heritability coupled with high genetic advance (GA) were estimates for leaf area (98 and 68 %) followed by dry matter (97 and 22.64 %) and yield per plant (78 and 35 %).

The research was conducted to study the genetic variability, heritability and genetic advance (GA) for quantitative as well as qualitative characters among twenty-five genotypes of orange flesh sweet potato (Badu *et al.*, 2017). The results concluded that high magnitude of Genotypic coefficient of variation and Phenotypic coefficient of variation were observed for leaf area, width of leaf lobe, total leaf dry weight, vine length, internodal length, number of branches per plant, whole plant fresh weight, dry weight of whole plant, fresh and dry weight of root, specific leaf area, specific leaf weight, leaf area index, crop growth rate, net assimilation rate, total chlorophyll, chlorophyll a, chlorophyll b, reducing and non-reducing sugar, total sugar,  $\beta$ -carotene, number of tubers per plant, tuber girth, yield of tuber per plant and tuber yield per hectare shows that presence of wide range of genetic variability in the germplasm for these characters.

Darshan *et al.* (2017) reported that characters like plant height (cm), stem girth (cm), root length (cm), number of tuberous roots and tuber girth (cm) noticed moderate PCV, GCV values and number of tubers exhibited higher Genotypic coefficient of variation and Phenotypic coefficient of variation values representing greater variation for these characters and thus there is greater scope for further improvement by genetic exploitation. All the characters exhibited high broad sense heritability in F<sub>1</sub> seedlings of cassava.

Kamalkumaran and Arumugam (2017) studied seventy-three accessions of sweet potato. Among which highest vine length ranged from 92.57 cm (lb17) to 317.24 cm (lb4), tuber length ranged from 9.61 cm (lb9) to 24.74 (lb63) and tuber girth ranged from 2.43 cm (lb41) to 8.43 cm (lb36) and CO-5 excelled with high tuber yield (315.31 kg/plant) and carotene content (20.02 $\mu$ g/gm).

Panigrahi *et al.* (2017) studied genetic variability of yield attributes for medium and late maturing potato cultivars. The results showed that wide range of variation has been observed for all the traits both in early and late harvesting situation. The high heritability was observed for total tuber yield and marketable tuber yield per plant and dry matter percentage.

Ramachandra and Srinivasa (2017) studied genetic variability, heritability and also genetic advance (GA) for quantitative as well as qualitative traits in sweet potato [*Ipomoea batatas* (L.) lam.] genotypes under hill zone of Karnataka. The analysis of variance noticed that the existence of sufficient amount of variability among genotypes for all the characters. In general, the phenotypic variance (PV) was higher than the genotypic variance (GV). Among different characters studied fresh weight of tuber, dry weight of tuber, tuber volume, total tuber yield per plant and marketable yield per plant, plot and hectare had the highest magnitude of GCV and PCV. The estimates of heritability showed that characters namely, plant height, leaf area, total fresh weight of plant and total dry weight of plant at 60 and 90 days after planting, fresh weight of tuber, tuber volume, total tuber yield per plant and marketable yield per plant, plot and hectare, total chlorophyll, non-reducing sugars, total sugars and starch were recorded with high heritability. Whereas leaf area, fresh weight of tuber, tuber volume, total tuber yield per plant and marketable yield per plant, plot and hectare and non-reducing sugars exhibited high GA, high heritability coupled with high GAM.

Badu *et al.* (2017) observed the high heritability (>60 %) coupled with high estimates from genetic gain as percent of mean (>20 %) was observed for starch, reducing sugar, non-reducing sugar, total sugar,  $\beta$ -carotene, number of root tubers per plant, root tuber length, root tuber girth, root tuber yield per plant and root tuber yield per hectare indicated that the heritability due to additive gene effects.

Studies on high heritability and genetic advance as per cent of mean for growth, yield and quality traits among sweet potato [*Ipomoea batatas* (L.) lam.] genotypes indicated that yield per plot followed by  $\beta$ -carotene content, non-reducing sugars, tuber yield per plant, leaf area, vine length, length of petiole, number of tuberous roots per vine, number of branches per vine, ash content, tuber width, internodal length, total sugars, reducing sugars and tuber girth exhibited high value of PCV and GCV (Narasimhamurthy *et al.*, 2018).

Sharavati *et al.* (2018) noted on analysis of variance shows the presence of genetic variation among yield and growth parameters. High heritability coupled with higher genetic advance (GA) was observed for several growth parameters such as vine length, total leaves per vine, inter nodal length, vine girth, chlorophyll content, leaf area, tuber length, tuber girth, weight of tuber, dry weight of vine, tuber yield per vine, total tuber yield per plot and marketable yield per hectare.

Study on the heritability of  $M_1V_3$  generation cassava (*Manihot esculenta* Crantz) mutants was conducted by Yani *et al.* (2018). The results showed that gamma-ray irradiation increased variability among five cassava genotypes. Characters that had high heritability were the length of leaf lobe, length of the petiole, stem diameter and the height of the plant.

Gehan (2019) observed the extent of genetic variability and heritability higher for dry matter and low for root girth of four different varieties across two cycles. Combined analysis of variance revealed highly significant genotypic effect for all the traits. Highest genetic advance (GA) as per cent of the mean was recorded for root length, vine length, number of roots per plant, root weight per plant.

Ali Zeleke (2020) conducted study on genetic variability of potato genotypes for yield and yield associated characters. The results showed that significant ( $p < 0.001$ ) difference observed for all character expect stem number per hill. Total tuber yield and marketable tuber yield were ranged from 13 to 52.23 and 11.95 to 46.16 (t/ha) respectively. The PVC and GCV ranged between 4.56 to 56.01 per cent and 2.32 to 40.66 per cent, heritability and genetic advance (GA) as per cent of mean ranged from 25.93 to 97.05 per cent and 2.44 to 82.64 per cent respectively.

Experiment on genetic variability of tuber yield and storage related traits in potato (*Solanum tuberosum* L.) were conducted by (Prajapati *et al.*, 2020). The results revealed that high heritability coupled with high genetic advance (GA) observed for growth parameters such as plant height, leaf area, fresh weight of tops per plant, number of tubers per plant, yield of tuber per plant, average tuber weight, physiological weight loss, loss due to rottage on weight basis, loss due to rottage on number basis and total weight loss, suggesting that existence of wide range of variability would be effective for selecting for these traits.

An experiment was conducted on genetic variability in twenty-four potato genotypes in order to find out the genetic variability. The genotypes showed highly significant difference for all the characters studied. The phenotypic (PCV) and genotypic (GCV) coefficient of variation computed ranged from 0.90 to 46.43 per cent and 0.75 to 40.0 per cent respectively. Shoot dry mass weight, average number of tubers, average tuber weight, unmarketable tuber yield, small size tuber and large size tubers exhibited high value of phenotypic and genotypic coefficients of variation coupled with high heritability (Seid *et al.*, 2020).

Mekonnen *et al.* (2021) conducted an experiment to determine the variability for yield and yield related traits in twenty four orange fleshed sweet potato [*Ipomoea batatas* (L.) Lam] genotypes. High heritability coupled with high genetic advances as a percent of mean were observed for marketable root yield, skin color of root, beta carotene content of tuber, harvest index, vine length, internodal length and above ground fresh weight. And these several characters are governed by additive gene action and for such traits selection would be feasible.

Thakur *et al.* (2021) studied on eighteen accessions of taro result revealed that significant variation was observed in vegetative and yield parameters. This study provides information regarding genetic variability and morphological characters of taro.

## **2.2 Correlation coefficient studies**

Yield is composite attribute and is the sum total of a number of units. Correlation coefficient analysis estimates the mutual relationship between several plant characters and determines the component characters on which selection can be based on improvement in yield. Correlation statistically fixes the interrelationship association of characters.

Tuber yield is one of the complex quantitative characters and greatly govern by various characters. The relationship among tuber yield and other associated characters could be obtained by simple correlation studies. Hence, correlation coefficients have got huge practical value in illuminating the extent of the relationship between various characters. For any breeding program estimation of genotypic and phenotypic correlation between various characters may provide information when selection is based

on two or more characters simultaneously. Such study would help us to know the suitability of various characters for indirect selection, because selection for one or more traits results in a correlated response in several other traits.

Amarchandra (1997) revealed that different growth and yield parameters *viz.*, number of tuber per plant, length of tuber and fresh weight per tuber were positively correlated with tuber yield.

Alam *et al.* (1998) noted on fifteen genotypes of sweet potato and reported that yield parameters *viz.*, number of tubers per plant, width of tuber and mean weight of individual tuber were positively correlated with tuber yield while vine length had negative significant correlation with the yield at both genotypic and phenotypic levels.

Parida *et al.* (1999) studied that total tuber yield had significant positively correlated with marketable tuber yield and numbers of tubers per plant.

Evaluation of fifty genotypes of sweet potato done by Choudhary *et al.* (2000). And result showed that length of petiole and tuber width was highly significant and positive phenotypic correlation with total tuber yield.

Hossain *et al.* (2000) evaluated thirty sweet potato genotypes Results showed that, root characters *viz.*, tuber diameter ( $r = 0.756$ ), average weight of tuber ( $r = 0.729$ ) and a number of tubers per plant ( $r = 0.635$ ) were positively and significantly correlated with root yield.

Eight clones of sweet potato studied by Perez *et al.* (2001). And results showed that weight of tuber and total plant weight were significantly and positively correlated with tuber yield.

An experiment on eighty six genotypes of sweet potato [*Ipomoea batatas* (L.) Lam.] for correlation coefficients of diverse origin by (Teshome *et al.*, 2004). The results revealed that the characters *viz.* number of branches per plant, weight of single tuber, length and girth of tuber showed higher estimates of PCV and GCV coupled with higher positive significant association with tuber yield.

Joseph *et al.* (2005) observed height of the Plant was positively correlated with a number of leaves and tuber yield with average tuber weight at all the locations. Tuber yield was not associated with any of the foliage characters.

Sahu *et al.* (2005) Studied on twenty-four sweet potato genotypes. And they observed that diameter of tuber, biological yield per plant and harvest index were positively and significantly correlated with tuber yield whereas vine weight per plant had a positive correlation with vine length.

An experiment done on thirty genotypes of sweet potato and noted that individual storage root weight, harvest index and storage root girth had a positive and significant correlation with storage root yield whereas the individual storage root weight and storage root girth, was negatively and significantly associated with number of storage roots per plant by (Engida *et al.* 2006).

Aina *et al.* (2007) studied in charter association for genotypes of cassava in four ecological zones in Nigeria. And result showed that root yield had highly significantly correlated with root parameters like medium-sized roots with a correlation coefficient (r) of 0.95, number of roots (r=0.91) and small-sized roots (r=0.77).

Sattar *et al.* (2007) evaluated twenty genotypes of potato and result showed tuber yield plant had a high degree of positive correlation with the plant vigour, number of compound leaves per plant and number of tubers per plant, mean weight of a tuber and tuber dry matter.

Shashikanth *et al.* (2008) studied that tuber yield had positively and significantly correlated with tubers characters like diameter of tuber, dry matter of tuber, starch and sugar content and fresh weight of vine.

Padma *et al.* (2009) conducted a research on Correlation studies in edible cassava germplasm. And result noted on characters like height of the plant, weight of the tuber and tuber girth was positively and significantly associated with tuber yield.

Yohannes *et al.* (2010) studied that diameter of tuberous root and mean weight of storage root were positively but non-significantly associated with total storage root yield (0.891 and 0.614, respectively). On the converse, total storage root yield was

negatively correlated with root dry matter content and root length (- 0.833 and -0.791, respectively).

Total root yield exhibited positive and significant ( $P < 0.01$  and  $P < 0.001$ ) associated with that all the characters, except stand count at harvest, reported by (Afuape *et al.*, 2011).

Anil *et al.* (2011) reported highly significant ( $P < 0.01$ ) correlation coefficient between width of petiole base and corm diameter, corm height, corm weight, east-west spread and north-south spread suggests that width of petiole and canopy spread are indicators to corm weight and size in seventeen wild elephant foot yam collections from Southwest India.

Research work on twenty-five genotypes of sweet potato done by (Choudhary and Mishra 2011) and result revealed that marketable tuber yield exhibited significant and positive correlation with number of tubers per plant.

Felenji *et al.* (2011) reported the correlation coefficient among different traits *viz.*, tuber yield, tuber weight, stolon length, number of tubers per plant, dry matter per cent, number of stems per plant, plant height, harvest index, stem diagonal and biological yield. Correlation coefficient showed that tuber yield had a positive and significant correlation with tuber weight and harvest index.

Khayatnez *et al.* (2011) found stronger positive and significant correlation between starch content and dry matter content ( $r=1$ ). Similarly, tuber yield exhibited strong positive correlation with a number of main stems per plant ( $r=0.925$ ), plant tuber weight ( $r=0.992$ ) and plant height ( $r=0.843$ ).

Paul *et al.* (2011) conducted the correlation and path coefficient studies for plant characters in aqua aroids (*Colocasia esculenta* L. Schott). The results showed that the yield per plant showed significant and positive phenotypic correlation with petiole length (0.481), leaf length (0.576), leaf breadth (0.918), leaf number (0.620), inflorescence length (0.662), spathe length (0.890) and spathe breadth (0.992). The residual effect was 0.2205 which indicated that characters studied contributed 78 per

cent of yield per plant. At genotypic level, yield per plant expressed positive and significant correlation with plant height (0.560) and leaf number (0.600). The residual effect (0.424) indicated that about 58 per cent yield was contributed by these characters.

Tirkey *et al.* (2011) reported that tuber yield represents significantly positive association with vine weight at both genotypic and phenotypic levels.

Agili *et al.* (2012) reported that several abiotic parameters like Stress Tolerance Index (STI), Mean Productivity (MP) and Geometric Mean Productivity (GMP) had highly significant positive correlation coefficients with yield potential ( $Y_p$ ) and stress yield ( $Y_s$ ) and they can be used as the most popular indices for selecting drought tolerance genotypes.

Bisognin *et al.* (2012) observed the character association for potato tuber shape and fresh weight with strong correlation in the early generation of selection. And they observed minimum correlation (0.348) was between length and smaller diameter of potato tuber.

Tuber yield per plant had a positive correlation with biological yield per plant, harvest index, marketable tuber yield per plant and diameter of the tuber Jha (2012).

Phenotypic coefficients of variation values were larger than their genotypic coefficient of variation values for all the characters was reported by (Boakye *et al.*, 2013) also stated that Correlations between these traits were highly significant and positive suggesting that consecutive progress for these traits is feasible.

Fekadu *et al.* (2013) reported that tuber yield was positively associated with plant height, biological yield and harvest index at both the phenotypic and genotypic levels. Whereas negative correlation was found in small and medium tuber percentage at both levels.

Okpara *et al.* (2013) studied the character association of fresh root yield of high and low cyanide in cassava. The results showed that there was a significant ( $P \leq 0.05$ ) positive correlation between root yield and number of roots per plant with correlation coefficients ( $r$ ) of 0.57, average weight of root ( $r = 0.58$ ) in high-cyanide cassava

genotypes, while in low cyanide cassava genotypes, fresh root yield was highly significantly ( $P \leq 0.01$ ) correlated with average weight of root ( $r = 0.74$ ).

Rangare and Rangare (2013) observed that the total tuber yield has positive and significant correlation both at the phenotypic and genotypic levels. Also the tuber yield showed significant positive correlation with marketable tuber yield both at the genotypic and phenotypic levels with percent plant emergence, number of tubers per plant and fresh weight of tubers per plant.

Positive and significant correlation between mean weight of tuber and yield per plant (g) found in sweet potato was reported by (Abdelmonem and Gendy, 2014).

Highly significant and positive correlations were found between root yield and plant height ( $r = 0.5436$ ), stem girth ( $r = 0.3874$ ), roots per plant ( $r = 0.7053$ ) and harvest index ( $r = 0.3025$ ) in cassava reported by Kundy *et al.* (2014).

Thirty-one genotypes of potato studied by Nasiruddin *et al.* (2014) and result showed that several growth parameters like height of the plant, number main stems per plant, canopy size, leaf area per plant and dry matter (%) had a significant and positive association with tuber yield per plant. They illustrate that these characters have a high and positive correlation with tuber yield per plant.

Correlation studies of yield and yield contributing characters and quality parameters of elephant foot yam revealed that the corm yield had negative and significant correlation with days to 50 per cent emergence ( $r = - 0.934$ ). However, it showed positive and significant correlation with plant height ( $r = 0.938$ ), pseudo-stem girth ( $r = 0.966$ ), number of pseudo-stem per plant ( $r = 0.932$ ), canopy spread ( $r = 0.964$ ), days to maturity ( $r = 0.972$ ), corm yield per plant ( $r = 0.969$ ), corm diameter ( $r = 0.968$ ), dry matter content of corm ( $r = 0.930$ ) and starch content of corm ( $r = 0.887$ ) (Sahu and Kumar, 2014).

Study on character association in cassava germplasma was carried out by (Rao *et al.*, 2015). Character association specified that various growth and yield parameters length of petiole, number of leaves per plant, total leaf area, stem diameter, tuber

diameter, plant dry matter content, starch content and hydrogen cyanide (HCN) content had positive and significantly associated with total tuber yield per hectare.

Twenty nine sweet potato genotypes evaluated by Tripathi *et al.* (2016). Result revealed that tuber yield was positively and significantly correlated with length of tuber, number of tubers per plant and vine length.

Correlation coefficient for yield traits in potato reported by Mishra *et al.* (2017). And result showed that characters like, fresh weight of tuber, number of tubers per plant, number of leaves per plant, tuber dry weight percent, number of compound leaves and harvest index percentage had positively correlated with the total tuber yield.

Panigrahi *et al.* (2017) studied on character association among yield and yield attributing traits for medium and late maturing potato cultivars. And research revealed that total tuber yield had significant positive association with germination percentage, non-marketable tuber yield and marketable tuber yield both at genotypic and phenotypic levels.

Rao *et al.* (2017) studied the correlation of cassava genotypes and result revealed that total leaf area, plant dry matter, tuber dry matter content, number of leaves per plant, plant height, stem diameter, number of storage roots per plant, number of commercial roots per plant, length of tuber, tuber diameter and harvest index had positive and significant correlation with tuber yield per plant (t/ha) at both phenotypic and genotypic levels, representing the importance of these traits in selection for yield.

Gurumu *et al.* (2018) conducted an experiment on twenty five genotypes and reported that root yield had positive and significantly correlation with beta carotene content and root flesh color ( $r=0.76$ ) whereas dry matter of root was negatively and significantly correlated with flesh color of root ( $r = -0.47$ ) and beta carotene ( $r = -0.40$ ).

Sharavati *et al.* (2018) observed that among thirty genotypes of sweet potato. Maximum number of tuber per vine, maximum length of tuber, maximum girth of tuber and maximum tuber yield was noticed in genotype BSP-29 followed by BSP-18.

Shellikeri *et al.* (2019) resulted that tuber yield were positively and significantly correlated with height of the plant and number of leaves, petiole length and leaf area at both phenotypic and genotypic levels.

Ali Zeleke, (2020) evaluated thirty-six genotypes of potato evaluated for eighteen character with respective to tuber yield and reported that total tuber yield (t/ha) per plant had positive correlation with most of the traits at both phenotypic and genotypic level.

Correlation studies in sweet potato genotypes revealed that total tuber yield was positively and highly significantly correlated with number of tuberous roots per plot (0.7740\*\*) and weight of tuber per plot(0.7804\*\*) (Magaji and Sodangi, 2020).

Mekonnen *et al.* (2020) conducted experiment on twenty four sweet potato genotypes and reported that yield parameters like number of roots per plant, length of root, width of root and harvest index are significantly and positively correlation with storage root yield.

Vandana *et al.* (2020) conducted the correlation and path coefficient studies for yield characters in greater yam [*Dioscorea alata* L.]. The result showed that the width of leaf, tuber weight, petiole length, tuber diameter and vine length are significantly and positively correlated with tuber yield.

### **2.3 Path coefficient analysis**

Lowe Wilson (1975) reported that tuber girth was related to mean tuber weight and tuber yield. Tuber girth appeared to be the most important characteristic feature of yield in their study.

Tuber yield of sweet potato associated with maximum positive direct effect on weight of the foliage (Thamburaj and Muthukrishnan, 1976). And also reported that tuber girth and number of tubers per vine had maximum positive direct effect on tuber yield.

Lin (1983) revealed that tuberous root yield per plant had positive direct association with number of branches per plant.

Ibrahim (1987) reported that root characters *viz.* girth of tuber, number of tubers and length of tuber showed higher path values than shoot characters and finally accomplished that less importance may be given for shoot characters in a breeding programme for yield.

Nanda (1994) reported that the tuberous root characters *viz.*, tuber girth, length of tuber, neck length of tuber and number of tuberous roots per plant had positive and direct effect on tuber yield.

Chen feng xiang (1995) studied on thirty sweet potato genotypes and reported that high yielding genotypes having more tuberous root, vital growth, more leaves and shorter vines.

Tuber yield of sweet potato had maximum positive direct association with tuber girth and tuber weight observed by (Kumar *et al.*, 1996). They noticed that number of branches had moderately high positive direct effect on tuber yield.

Naskar *et al.* (1996) revealed that length of tuberous root showed the maximum positive direct effect on yield, while vine length, internodal length and number of branches had negative direct association with yield. They also confirmed that improving the yield in sweet potato through most desirable characters like petiole length, length of tuber and girth of tuberous root.

Rajesh Kumar Jain and Ganguli (1996) studied on twenty five genotypes of sweet potato and revealed that the maximum direct effect (0.74) on tuber yield was through tuber weight, Tuber width, number of branches and number of tubers also had direct effects on tuber yield.

Alam *et al.* (1998) conducted study on fifteen genotypes of sweet potato. Results showed that maximum positive direct effect of tubers per plant and tuber width on tuber yield. And also observed that vine length had a maximum negative direct effect on yield.

Marketable tuber yield and number of tubers per plant had a direct effect on tuber yield Parida *et al.* (1999).

Evaluation of fifty sweet potato genotypes studied by (Choudhary *et al.*, 2000). Results showed that positive direct effect of tuber yield per plant and marketable tuber yield on tuber yield.

A study was conducted on thirty genotypes of sweet potato by (Hossain *et al.*, 2000). Results noted that tuber yield was influenced by mean weight of tuber and number of tubers per plant.

Sahu *et al.* (2005) studied on twenty four sweet potato genotypes and revealed that the number of marketable tubers had a direct positive effect on tuber yield whereas vine weight had positive indirect effects on tuber yield via tuber yield per plant and marketable tuber yield. Neck length of tuber, length of tuber, tuber diameter, biological yield, harvest index, total soluble solids, dry matter content of foliage and dry matter content of tuber also exhibited positive indirect effects on tuber yield.

Engida *et al.* (2006) conducted a study on thirty sweet potato genotypes and revealed that individual storage root weight, number of storage roots per plant and harvest index had direct effect on storage root yield.

The tuber yield per plant had the highest direct effect towards total tuber yield followed by a number of tubers per plant and per cent marketable tuber yield (Roy and Singh, 2006).

An experiment on Path analysis for cassava genotypes in four ecological zones in Nigeria studied by (Aina *et al.*, 2007). Research revealed that root yield was influenced by number of roots per plant. And small sized roots had a positive direct effect on root yield ( $p=1.21$ ) but a positive indirect effect ( $p=1.91$ ) *via* number of roots.

Regassa and Basavaraj (2007) studied path coefficient analysis in 100 accessions during *kharif* 2003 and 2004. The results revealed that seven out of eight genotypes had a positive direct effect on the tuber yield. However, plant spread and weight of small tubers per plant had negative direct influence only at genotypic level. Plant height has been observed to put forth negative direct effect both at phenotypic and genotypic levels regardless of its positive and higher correlation with the yield both at phenotypic and

genotypic levels. The weight of large size tubers per plant exerted the maximum positive direct effect on tuber yield at both phenotypic and genotypic levels followed by weight of medium size tubers per plant. The maximum positive indirect effect was exerted on yield by a number of main stems per plant through weight of large size tubers per plant at genotypic level. This was followed by plant height and plant spread through the weight of large size tubers per plant both at phenotypic and genotypic levels.

Chandrakar (2007) observed that direct selection of the traits such as weight of tuber per plant, harvest index per cent and number of shoots per plant must be used for the enhancing tuber yield.

Average weight of tuber and a total number of tubers per plant contributed the maximum direct effect to tuber yield indicating their importance as selection index for yield enhancement (Sattar *et al.*, 2007).

Shashikanth *et al.* (2008) revealed that tuber yield had direct influence with total number of tubers per vine.

Ara *et al.* (2009) revealed that tuber yield is directly positive associated with highest number of shoots (0.716) followed by plant fresh weight at 80 days after planting (0.464) and number of leaves per plant (0.341).

Mondal *et al.* (2009) evaluated thirty one genotypes of potato in order to find out path coefficient of tuber yield and its component characters. They noted that tuber weight per plant is direct positive associated with plant height at 50, 70 and 90 days after planting, number of stems per plant, individual tuber weight per plant and tuber weight-loss percentage at 150 days after harvest.

Padma *et al.* (2009) studied on path analysis for cassava germplasm reported that weight of tuber followed by height of the plant had a highly positive direct effect on tuber yield. Therefore, importance should be given for tuber weight, height of plant and also tuber girth while selecting a good genotype for increasing the yield of cassava.

Choudhary and Mishra (2011) Studied on twelve genotypes of sweet potato reported that tuber yield had positive direct association with number of tubers per plant.

Tirkey *et al.* (2011) revealed that tuber yield had positive direct association with marketable tuber yield, biological yield, tuber diameter and dry matter per cent of the tuber, neck length of the tuber, length of tuber.

Jha (2012) Studied on path co-efficient analysis revealed that biological yield per plant was important trait influencing on tuber yield.

Experiment on path analysis of fresh root yield of high and low cyanide cassava cultivars conducted by (Okpara *et al.*, 2013). The results revealed that mean weight of cassava root tuber had direct effect on high cyanide (0.66) and low cyanide (0.67) in cassava genotypes. Also, the number of roots per plant in both types of cassava dispense a positive direct effect on fresh root yield, however, a minimum effect was obtained by a number of leaves per plant (0.22) in high-cyanide cassava genotypes and total number of stems per plant (-0.13) in low cyanide cassava genotypes.

Experiment on path analysis for various growth parameter *viz.*, vine length, number of branches per vine, total number of tubers per vine, tubers mean weight, tuber dry matter, total yield of tuber and total marketable yield studied by (Patel *et al.* 2013). Results showed that total tuber yield for marketable yield was influenced by higher positive direct effect.

Study on path analysis for yield and its contributing characters carried out by Ummyiah *et al.* (2013) the mean weight of tuber showed highest positive direct effect on tuber yield per plant followed by a number of tubers per plant, stolon length and plant height suggesting that tuber yield in potato is strongly influenced by above mentioned traits.

Kundy *et al.* (2014) Studied on path coefficient between yield and yield related traits in cassava. Results revealed that path analysis of roots per plant, plant height and root size had highest direct influence 0.619, 0.290 and 0.153, respectively. Therefore,

improving these characters through indirect selection for higher root yield may be effective.

Study on path analysis in cassava carried out by Rao *et al.* (2015). Results proved that tuber yield per plant had positive direct effect on number of leaves per plant, stem and tuber diameter, number of tubers per plant and plant dry matter content. The high direct effect of these traits appeared to be the main factor for their strong association with tuber yield per hectare.

Research on forty-eight genotypes of potato carried out by Verma and Singh (2015) using path analysis including four checks and evaluated for nine quantitative traits in an augmented block design during the rabi season. Results revealed that tuber yield possessed highest positive direct on various yield parameters and yield of tuber per plant had a effect on total tuber yield. This study was showed that plant height, number of tubers per plant, marketable yield per plot and tuber yield per plant were main traits for tuber yield.

Mukherjee *et al.* (2016) studied on path analysis for phenotypic and yield attributing characters of taro. Results revealed that weight of cormels per plant possessed the highest direct effect on tuber yield indicating the consequence of selection based on this character to enhance the tuber yield of plant.

Experiment on path analysis studied by (Mishra *et al.*, 2017) for yield attributing characters in potato. Results revealed that total tuber yield has positive and direct associated with the fresh weight of tubers, followed by plant canopy cover percentage, number of tubers, dry weight of shoots and number of leaves.

An experiment on path analysis of cassava genotypes studied by (Rao *et al.*, 2017). Research revealed that diameter of stem and tuber indicates higher positive and direct effect on tuber yield. The direct effect of these characters showed most important factors for strong correlation with tuber yield per plant.

Gurmu *et al.* (2018) reported that the direct effect on fresh root yield was positive due to characters *viz.*, individual root weight (0.821), number of tuberous roots

per plant (0.776), root dry matter content (0.276) and above-ground fresh weight (0.410).

Study on high heritability correlation and selection parameters of M1V3 production of cassava (*Manihot esculenta* Crantz) mutants by (Yani *et al.*, 2018). The path analysis showed that mean weight of tuber closely associated with total number of tubers per vine, height to first branch and diameter of stem. And found that, for production of M1V4 mutants these characters are feasible.

A study was conducted on thirty-six potato genotypes of potato by (Ali Zeleke, 2020). Results showed that total tuber yield (t/ha) had a direct effect on marketable, unmarketable tuber number per hill and mean weight of tuber (g) at both genotypic and phenotypic level.

A study conducted by Ashish *et al.* (2020) on genetic variability for agro morphological and yield attributing traits of elephant foot yam. The highest phenotypic and genotypic coefficient of variance was recorded for parameters like number of cormels per plant, weight of corm per plant, length of pseudostem, days to sprouting, girth of pseudostem, calcium oxalate, chlorophyll content and leaf canopy diameter exhibited considerably higher heritability coupled with high genetic advance representing that these traits could be used for improvement such characters.

A study was conducted on twenty four genotypes of sweet potato by Mekonnen *et al.* (2020). Results showed that storage root yield had a direct effect on number of roots per plant, root girth and harvest index.

Study on thirty genotypes of greater yam revealed that tuber yield per vine had a direct effect on dry matter, moisture, number of leaves, tuber diameter and petiole length, number of sprouts per seed tuber, total phenol, internodal length, starch content, tuber weight, ascorbic acid and total sugar indicating direct selection for these characters is done for improving tuber yield (Vandana *et al.*, 2020).

## 2.4 Post harvest studies and Quality parameter

Miller (1958) observed that high carbohydrates and starch content is significantly associated with genetic makeup of the genotype.

Ramaswamy and Muthukrishnan (1982) observed highest per cent of starch (30.72%) was found in CO-3 variety of sweet potato.

Hamilton *et al.* (1985) reported that highest dry matter of tuber was found in 'Hidry' (39.80%) variety of sweet potato.

Hegde *et al.* (1986) reported that higher starch content (30.09%) was found in cultivar C-71 followed by OP-217 (29.53%).

Hegde *et al.* (1986) revealed that C-71 genotype recorded highest sugar content (1.10%) and about least (0.48%) in C-43 genotype.

Nair *et al.* (1986) observed that highest dry matter per cent (26.20) and sugar content (2.4 %) was found in H-80/168 Hybrid of sweet potato. And also recorded new high carotene content of about 22 per cent.

Collins and Moyer, 1987a reported that highest dry weight of tuber (24 %) recorded in 'Sweet Red' variety of sweet potato.

Collins and Moyer, 1987b reported that highest dry matter (26 %) content in 'White Delite' roots of sweet potato variety.

Dukes *et al.* (1987) found that highest starch per cent (55-60 %) recorded in Sumor, a multi-use sweet potato variety.

Sen *et al.* (1990) reported that highest dry matter of tuber was found in X-24 at 90days after planting (28.35%) and 105 days after planting (29.85%) followed by X-69 (28.20% and 29.00%).

H-633 (34.70%) variety of sweet potato recorded highest tuber dry matter followed by Pusa Red (33.60 %) studied by Upadhyaya and Edison (1991).

Akkamahadevi *et al.* (1996) reported that Belgam local has the maximum starch content of about 84.7 per cent on dry weight basis.

Vimala and Rajendran (1998) reported that highest dry matter content was found in Sree Bhadra (33.30 %) and SreeRethna (31 %) short duration sweet potato varieties.

Anshebo *et al.* (2003) observed that maximum starch content was found in IGSP-9 (34.66 %) clone and RSNP-1 (16.38 %) clone has showed lowest starch content under Coimbatore condition.

Shau (2003) reported that IB-90-15-9 genotype recorded highest total soluble solids for Chhattisgarh plains.

Teshome *et al.* (2003) reported highest starch content in clone IGSP-9 (34.66%) and lowest in RNSP-1 (16.38%) under Coimbatore conditions.

Experiment conducted on nutrient composition of corms of elephant foot yam by Chattopadhyay *et al.* (2010). Maximum dry matter and starch (fresh weight basis) content was found in NDA-9 (32.50 % and 28.70 %), minimum in Midnapur (17.50 % and 11.75 %).

Changes in the carotenoid content during 35 days of storage in ten orange-fleshed sweet potato clones was observed by Binu *et al.* (2011). Significant variation in total carotenoids content (10.32- 13.99mg/100g fresh weight) and  $\beta$ -carotene (9.02- 12.6mg/100g fresh weight) was noticed among the clones and they also studied the changes in dry matter content during 35 days of storage in 10 orange-fleshed sweet potato clones and observed that gradual decrease in dry matter content from 24.1 to 25.5 per cent.

Pushpalata *et al.* (2011) studied on fifteen genotypes of sweet potato and recorded observations on starch percentage, total sugar percentage, carbohydrate percentage and TSS. Results revealed that genotypes like IGSP.C-18, 440038, 440036 and IGSP.C-16 were shows superior to Sree Rethna in respect of quality parameters.

Evaluation of 1600 orange-fleshed sweet potato genotypes studied by (Vimala *et al.* 2011). And observed a more genetic variation for the skin color of tuber (pink, purple and purple to light pink color) and root flesh color (orange, light orange, dark orange and creamy to yellow color).

Evaluation of forty clones of orange fleshed sweet potato during different season *viz*, *kharif* summer, rabi was observed by vimala *et al.* (2011a) and that total carotenoid content ranges form 8.5-15 mg/100g fresh weight and beta carotene varied form 6.8-13.7 mg/100 g fresh weight.

Vimala *et al.* (2011b) evaluated 42 orange-fleshed sweet potato hybrids in upland and low land conditions for storage root yield and dry matter content along with a control variety of Sree Kanaka and observed that root yield ranged from 3.0 to 20.0 tonnes per hectare in upland, 3.0 to 30.0 tonnes per hectare in lowland condition and dry matter content varied from 18.5 to 29.2 per cent.

Mitra (2012) studied the orange fleshed sweet potato in alleviating vitamin A deficiency and assessment of nutritional quality in sweet potato tubers. The highest dry matter (26.52%) and starch content (17.38%) were observed in S-1281 and S-1156 respectively. The tubers of ST-14 (9740 mg/100g) and Kamala Sundari (6430 mg/100g) recorded higher value of beta carotene.

Evaluation of six genotypes of sweet potato carried out by Richardson (2012) for tuber quality and reported that the more variation showed in the leaf and tuber characteristics.

Desai *et al.* (2013) evaluated orange fleshed sweet potato genotypes (*Ipomoea batatas* L.) under South Gujarat conditions. Genotype 440127 recorded higher tuber yield (33.18 t/ha), which was 58.11 per cent higher than the check variety, Gouri. The highest dry matter (34.70 %) was recorded in the genotype ST-14, which was on par with the genotype S-1281 (31.20 %). The highest harvest index (0.514) was recorded in the genotype 440127.

Rahman *et al.* (2013) conducted research work on evaluation of orange fleshed sweet potato (*Ipomoea batatas* L.) genotypes for higher yield and quality. Result noted that genotype CIP 194513.15 recorded highest tuberous yield (31.59 t/ha). And maximum dry matter was found in H6/07 (29.83%) whereas minimum was found in CIP 441132 (17.61 %). They also observed CIP 440267.2 genotype recorded highest vitamin A (919.2 µg/100 g RE, FW) while minimum was in H6/07 (0.0 µg/100 g RE, FW).

Amare *et al.* (2014) evaluated sweet potato (*Ipomoea batatas*) varieties for total storage root yield and reported that the superior mean total root yield (26.82 t/ha) was obtained at Kukufto testing location while the inferior (13.45 t/ha) was at Rarhe. Similarly, among the genotypes, LO gave the highest mean total root yield (30.9 t/ha), while Bellela gave the lowest (7.78 t/ha). The AMMI analysis for the total storage root yield also showed the highly significant difference for genotypes, locations and interaction components.

Evaluation of taro germplasm conducted by Surjit and Tarafdar (2015). And noted that variations in starch content (13.71 % to 18.36 %) and cormels dry matter content varied from (22.77 % to 25.46 %).

Ali *et al.* (2015) Evaluated 116 accessions of sweet potato genotypes result revealed that had the highest reducing sugars was found in CN-1752-14. And CN-1752-15 recorded highest total starch and total sugar content whereas, Korojo had the highest dry matter content.

Kathabwalika *et al.* (2016) evaluated eight orange fleshed sweet potato genotypes observed significant variation among genotypes. From the experiment result revealed that higher dry matter 34.4 per cent and beta carotene was found in Zondeni and Maseya (4258.5 µg/100 g) while BV/009 genotype observed lowest (26.8%).

Nair *et al.* (2017) conducted experiment on evaluation of orange fleshed sweet potato genotypes for storage root yield and dry matter content. From the results it was

found that the rabi season is more favorable for total tuber yield production, Among the genotype, ST- 14/47 recorded highest tuber yield (27.19 t/ha) with 24 % dry matter.

Evaluation of sweet potato cultivars suitable for making several processed products done by Reddy *et al.* (2017). Experiment results revealed that total sugar varied from cultivar TSP 12-10 (5.31 %) to TSP 12-4 (9.54 %). The total carbohydrate were ranged from 18.86 per cent to 28.63 per cent in cultivar TSP 12-8, TSP 12-1, respectively protein content from 1.28 per cent in TSP 12-5 to 3.56 per cent in ST-14. Whereas the tubers of ST-14 (1.29 mg/100g) and TSP 12-10 (13.4 mg/100g) recorded higher value of beta carotene.

Sharavati *et al.* (2018) evaluated thirty sweet potato genotypes under hill zone of Karnataka state. Result noted that variation observed among several genotypes. While beta carotene and tritable acidity were found in BSP-23 and BSP-10 genotypes respectively.

Evaluation of two orange fleshed sweet potato genotypes with respect to root yield performance done by (Gurmu and Mekonen, 2019). Result noted that fresh root yield, root dry matter content, resistance to low weevil infestation and low score were found in Ukr/Eju-10 and Ukr/Eju-13 genotypes. They also observed that beta carotene content of two varieties (12.48 and 9.51 mg 100 g) was more as compared to the standard check Kulfo (6.91 mg 100 g) respectively.

Evaluation of twelve different sweet potato genotypes on shelf-life and physiochemical parameters for determining better storage studies. Experiment result revealed that BSP1 genotype found to be good and showed several superior quality parameters like high dry matter (61.7 %), low values for TSS (4.4 ° Brix), reducing and non reducing sugars (0.67 and 0.21 %), starch (0.60 %) and physiological loss in weight (13.5 %) throughout the storage period (Prathiksha and Naik K, 2019).

Shellikeri *et al.* (2019) conducted research on quality parameters of colocasia (*Colocasia esculenta* L.) Genotypes for calcium oxalate and dry matter content. Form the experiment result revealed that calcium oxalate (40.40 r 200-1 mf) was found less

amount in BCC-11 genotype. And observed variation in shelf life of leaves (10.42 to 13.95 hrs). Whereas starch content ranges from (13.57 % and 24.13b %).

Determination of shelf-life and physicochemical parameters of seven different orange fleshed sweet potato genotypes for better storage studies given by Thriveni *et al.* (2019) result revealed that genotype ST-14 (13.23 mg/100g) showed highest beta-carotene content with L\*a\*b values 78.58, 1.29 and 7.96 respectively. Also TSP 16-3 genotype showed lowest per cent of weevil infestation on 4 (5.05 %) and 8 (13.20 %) DAS.

### **3. MATERIAL AND METHOS**

The Present research work entitled “Evaluation of orange fleshed sweet potato (*Ipomoea batatas* L.) Genotypes” was carried out during *rabi* season 2020-2021 at Regional Horticultural Research and Extension Centre (RHREC), Kumbapur, Dharwad. The details methodologies used and statistical analysis utilized for conducting research and observation recorded during the course of the present investigation are described in this chapter.

#### **3.1 Geographical location of experiment site**

The experiment was conducted on sandy loam soil at main experimental station of Regional Horticulture Research and Extension center Dharwad (Kumbapur Farm). The site is located in the agro climatic zone-8 (Northern Transition Zone) of Karnataka state. Dharwad is geographically located at 15<sup>0</sup> 26<sup>1</sup> North latitude, 76<sup>0</sup> 27<sup>1</sup> East longitude and at an altitude of 678 m above mean sea level.

#### **3.2 Weather conditions of the experimental site**

The data with regard to rainfall, ambient temperature (maximum and minimum) that prevailed during the crop growth period as recorded at RHREC Dharwad are presented in Appendix 1.

#### **3.3 Experimental details**

##### **3.3.1 Design and experimental layout**

The experiment was laid out in Randomized Block Design (RCBD) with three replication and sixteen orange fleshed sweet potato genotypes. The details of the experiment are given in below. The treatments in each replication were allotted randomly by using random number table. The plan and layout of the experiment is given in the figure 1 and general view of experimental plot represented in the Plate 1.

### 3.3.2. Experimental materials

The experiment consists of 16 genotypes as in Table 1.

Location	: RHREC, Dharwad.
Design	: RCBD
Number of Genotypes	: 16
Replications	: 3
Spacing	: 60 cm × 20cm
Plot size	: 3 m × 3 m
Number of plants per plot	: 40

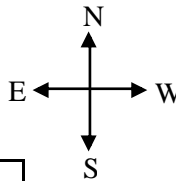
### 3.3.3. Treatment details

Sixteen orange fleshed sweet potato genotypes have been taken for research these were collected from AICRP on tuber crops, Dharwad. The list of genotypes and their salient features are furnished in the Table 1.

1. TSP 16-3	9. TSP-16-8
2. TSP 16-5	10. TSP-16-4
3. TSP 16-6	11. TSP-16-18
4. TSP-16-7	12. TSP-16-19
5. TSP-16-9	13. TSP-16-20
6. TSP-16-10	14. TSP-16-21
7. ST-14 (Bhu Sona)	15. TSP-16-32
8. BSP 23 (Local Check)	16. TSP-16-36

\*TSP-Tuber sweet potato

RI	RII	RIII
T-16	T-4	T-1
T-15	T-3	T-2
T-14	T-2	T-3
T-13	T-1	T-4
T-12	T-16	T-5
T-11	T-15	T-6
T-10	T-14	T-7
T-97	T-13	T-8
T-8	T-12	T-9
T-7	T-11	T-10
T-6	T-10	T-11
T-5	T-9	T-12
T-4	T-8	T-13
T-3	T-7	T-14
T-2	T-6	T-15
T-1	T-5	T-16



**Fig. 1. Layout of orange fleshed sweet potato**



**Plate 1: General view of the experimental plot**

## **3.4 Cultural Operation**

### **3.4.1 Preparation of experimental plot**

The land was brought to a fine tilth by repeated ploughing and requisite dimension of the plot was prepared as per the plan. Size of each micro plot was 3 × 3m. A spacing of 1.0 m between two replications and 0.5 m between two plots were maintained for lying of irrigation channels and bunds, respectively.

### **3.4.2 Planting**

Stem cuttings collected from AICRP on Tuber crops, Dharwad, were used for planting. The ridges and furrows were opened at 60 cm and planted one cutting on the ridge at 20 cm. The planting was done on 8<sup>th</sup> September, 2020 during the *rabi* season.

### **3.4.3 Application of manures and fertilizers**

Well decomposed FYM at 20 tonnes per hectare was applied at the time of land preparation along with recommended dose of NPK (75:50:75 kg/ha). Half dose of the nitrogen and potassium, a full dose of phosphorus were applied as basal dose before planting of stem cuttings and remaining half dose of nitrogen and potassium was applied after 6 weeks after planting, along with weeding and earthing up.

### **3.4.4 Weeding and irrigation**

The plots were kept weed-free by regular hand weeding at an interval of 20 to 25 days. Depending on the soil moisture status and climatic conditions, irrigation was given at an interval of 5 to 6 days during the entire experiment. Irrigation was stopped one week before the harvesting to allow tuber skin to become dry and firm.

### **3.4.5 Earthing up**

Earthing up was done at 30 to 35 days after planting to avoid exposure to sunlight in order to avoid greening of tubers.

**Table 1. List of genotypes used for the study with their salient features**

Sl. No	Genotype	Leaf shape	Tuber shape	Skin colour	Flesh colour
1	TSP 16-3	Deeply lobed	Round elliptic tubers	Purple skin	Dark orange
2	TSP 16-5	Very deeply lobed	Long irregular tubers	Orange colour	Orange flesh
3	TSP 16-6	Deeply lobed	Long irregular tubers	Pink skin	Orange flesh
4	TSP 16-7	Moderately lobed	Long oblong tubers	Orange skin	Dark flesh
5	TSP 16-9	Deeply lobed	Round elliptic tubers	Pink skin	Orange flesh
6	TSP 16-10	Very deeply lobed	Long oblong tubers	Purple skin	Orange flesh
7	ST-14 (Bhu Sona)	Lightly lobed	Round elliptic tubers	Orange color	Dark orange
8	TSP 16-8	Deeply lobed	Long irregular tubers	Cream skin	Pale orange
9	TSP 16-4	Moderately lobed	Oblong tubers	Purple skin	orange flesh
10	TSP 16-18	Lightly lobed	Long oblong tubers	Pink skin	Pale yellow
11	TSP 16-19	Very deeply lobed	Round elliptic tubers	Creamish skin	Orange flesh
12	TSP 16-20	Moderately lobed	Obovate tubers	Pink skin	Orange flesh
13	TSP 16-21	Moderately lobed	Long oblong tubers	Purple skin	Orange flesh
14	TSP 16-32	Lightly lobed	Obovate tubers	Cream skin	Dark orange
15	TSP 16-36	Deeply lobed	Long elliptic tubers	Pink skin	Orange flesh
16	BSP-23 (Local Check)	Very deeply lobed	Round elliptic tubers	Pink skin	Orange flesh

### **3.4.6 Plant protection**

The incidence of caterpillars was noticed at 30 days after planting and sweet potato weevil at 94 days after planting and it was controlled by spraying of chlorpyrifos (2 ml/lt).

### **3.4.7 Harvesting**

The crop was harvested by digging out the tubers according to their maturity at 150 days after planting.

## **3.5 Observations recorded on growth, yield and quality attributes**

### **3.5.1 Sampling procedure**

Five plants per treatment were selected randomly and tagged. Observations were recorded on selected tagged plants for different characters in each replication. The data recorded on five plants per treatment was averaged and subjected to statistical analysis.

### **3.5.2 Growth parameters**

#### **3.5.2.1 Vine length (cm)**

The vine length was recorded at 60, 90 and 120 days after planting. Vine length was precise in centimeter from ground level to tip of the highest branch.

#### **3.5.2.2 Number of branches per vine**

The branches arising from the basal portion of the main stem were counted at 90 and 120 days after planting. Average of five plants was recorded as a number of branches per Vine.

#### **3.5.2.3 Number of leaves per vine**

Fully opened leaves from each of five randomly selected plants were counted at 60, 90 and 120 days after planting. Five leaves were collected from each plant and the mean values of five plants were recorded as a number of leaves per plant.

#### **3.5.2.4 Leaf area (cm<sup>2</sup>)**

The leaf area of first five leaves from base of main vine were used for estimation of leaf area at 60, 90 and 120 days after planting will be recorded and. Leaf area meter was used for measuring leaf area and expressed as centimeter square per plant.

#### **3.5.2.5 Inter-nodal length (cm)**

The length between fifth and sixth nodes from the base of the main stem was recorded in centimeter at 60, 90 and 120 days after planting.

### **3.5.3 Yield parameters**

#### **3.5.3.1 Number of tubers per vine**

The numbers of tubers in each of the five tagged plants were counted. The mean was recorded as a number of tubers per vine.

#### **3.5.3.2 Tuber length (cm)**

Tuber length was recorded for five tubers from the tagged five plants and expressed in centimeters.

#### **3.5.3.3 Tuber girth (cm)**

Tuber girth was recorded from randomly chosen tagged five plants from each treatment and girth of tuber was measured with the help of vernier calipers and expressed in centimeters. The average of five plants was recorded as tuber girth.

#### **3.5.3.4 Mean weight of tuber (g)**

The weight of tubers in each grade was recorded in grams per plant during harvesting using sensitive balance and the average was recorded.

#### **3.5.3.5 Tuber yield per vine (g)**

Total tuber yield obtained from each five tagged plants was weighed and expressed in grams.

### 3.5.3.6 Tuber yield per plot (kg/plot)

The weight of the tubers harvested from each plot (including the tagged plants) was weighed and expressed in kilograms.

### 3.5.3.7 Tuber yield per hectare (t/ha)

The yield per hectare was calculated by multiplying the yield per plant (kg) with the number of plants per hectare and expressed in tones.

$$\text{Marketable yield (t/ha)} = \frac{\text{Plot yield}}{\text{Plot area}} \times \frac{10,000}{1000}$$

### 3.5.3.8 Tuber damage (%) by sweet potato weevil

During harvest, the number of tubers infested with weevil was recorded and values were summed up to get a total number of tubers infested for each experimental plot. The percent incidence of weevil under natural epiphytotic condition was calculated by using the formula as mentioned below.

$$\text{Per cent weevil incidence} = \frac{\text{Number of tubers infested}}{\text{Total number of tubers}} \times 100$$

#### Arcsine transformation:

Arcsine transformation of data is appropriate for the data on proportion, i.e., data obtained from a count and the data expressed as decimal fractions and percentages. The distribution of percentage is binomial and arcsine transformation of data makes the distribution normal.

The percent of tuber damage by sweet potato weevil was calculated in percentage and then the percent data was transformed using below mentioned Arcsine transformation formula.

$$= \text{DEGREES (ASIN(SQRT(X/100)))}$$

Where X indicates the percent value to be transformed

### **3.5.4 Quality parameters**

#### **3.5.4.1 Skin and flesh color**

The skin and flesh colors were noted on initial day, 15 and 30 days after storage.

They were analyzed by giving them scores out of five by visual means.

5 = Highly acceptable

4 = Acceptable

3 = Fairly acceptable

2 = Poorly acceptable

1 = Not acceptable

#### **3.5.4.2 Tuber appearance (Scores)**

The acceptability of sweet potato tubers was assessed based on general appearance using numerical scale ranging from 5 to 0 as suggested by Ranganna (1977).

Where,

5 = Excellent (equivalent to freshly harvested)

4 = Least shriveled

3 = Less shriveled

2 = Medium shriveled

1 = More shriveled

0 = Badly deteriorated

#### **3.5.4.3 Starch content**

The residue obtained by filtering the alcohol extract of the sample constituted the alcohol insoluble matter. A known amount of alcohol insoluble matter was

hydrolyzed using perchloric acid (52 %). The hydrolyzed fraction was centrifuged at 3000 rpm for 10 minutes. The supernatant liquid was collected and pooled. The process was repeated thrice increasing the centrifuging time from 10 to 15, 25 and 30 minutes, collecting the supernatant each time. This supernatant containing hydrolyzed starch was made up to 50 ml and was used for estimating sugars as per Dinitrosalicylic acid method as reducing sugars. The amount of starch on the dry weight basis was computed by multiplying the values of reducing sugar fraction by the factor 0.9 (Ranganna, 1977). It was expressed in percentage (%).

#### **3.5.4.4 Beta-carotene**

Beta-carotene was estimated in each treatment in all three replications by using acetone-hexane extraction method. About 5g of fresh tuber sample was taken from five tubers, which was macerated by using 85 per cent acetone, till all the carotenoids are dissolved. The extract was filtered through Whatman No.1 filter paper. Then 100ml of each distilled water and hexane were added to the extract in separating funnel. The solution was shaken properly and then allowed to settle. The lower layer of water was retained. The hexane fraction containing carotene was washed with distilled water for about three to four times with the help of separating funnel. The hexane fraction was then transferred to a conical flask and to this, a small quantity of anhydrous sodium sulphate was added to remove water completely in the funnel solution. The absorbance of the solution was taken at 448 nm in a spectrophotometer (Visiscan 167 spectrophotometer). It was expressed in mg/100 gm.

$$\text{Beta - carotene } (\mu\text{g}/100 \text{ gm}) = \frac{\text{O.D} \times 13.9 \times 10^4 \times 100}{\text{Weight of sample} \times 100}$$

#### **3.5.4.5 Dry matter content (%)**

Dry matter content of sweet potato tubers will be determined by drying the finely sliced piece of tuber in microwave oven at 40 and 60 power intensity until the constant weight was achieved. The dry weight was calculated using the following formula.

$$\text{Dry matter content (\%)} = \frac{W_2}{W_1} \times 100$$

Where,

$W_1$  = Fresh weight of the tubers (g)

$W_2$  = Dry weight of the tubers (g)

#### 3.5.4.6 Physiological loss of weight

The initial weight of the tubers was recorded on electric top pan balance in each treatment. Thereafter the weights of tubers under each treatment were recorded at four days interval after storage. The cumulative losses in weight were calculated and expressed as per cent physiological loss in weight.

Following is the formula used in calculating PLW

$$PLW = \frac{P_0 - P_1}{P_0}$$

Where,

$P_0$ - Initial weight

$P_1$ - Final weight

### 3.6 Statistical analysis of experimental data

The data collected from the experiment was subjected to the following analysis.

#### 3.6.1. Analysis of variance (ANOVA)

Analysis of variance was carried out as per the procedure given by Panse and Sukhatme (1957). The model of analysis of variance was as follows:

Source of variation	Degrees of Freedom (d.f)	Sum of Square (SS)	Mean sum of square (MSS)	'F' cal
Replication	r-1	RSS	RMSS	<u>Tr.MSS</u> EMSS
Genotype	t-1	Tr.SS	Tr.MSS	
Error	(r-1) (t-1)	ESS	EMSS	
Total	(rt-1)	TSS		

The mean values of the genotypes were used for analysis of variance. Replication wise mean values were subjected to RCBD analysis. The significance of difference among all genotypes was tested using 'F' test.

Where,

t = Number of treatments (genotypes)

r = Number of replications

SS = Sum of square

MSS = Mean sum of square

df = Degrees of freedom

The standard error was calculated as,

$$S.E.m \pm = \sqrt{EMSS/r}$$

The significance of treatment mean squares and replication mean squares were tested by comparing with error mean squares referring to 'F' table values at 5 and 1 per cent level of probabilities.

$$\text{Critical difference, CD} = \sqrt{2 \times S.E.m \times t(\alpha, df)}$$

Where,

$\alpha$  – level of significance (5 and 1 per cent) Edf – Error degrees of freedom.

The calculated F value is compared with the table F value for respective degrees of freedom (treatment df, error df) at 5 or 1 per cent level of significance.

### Mean, Range and Variance

The mean, range and variance values of each character were calculated for each genotype.

$$\text{Mean} = \frac{\text{Sum of observations of all the plants}}{\text{Number of plants}}$$

Range = The minimum and maximum values for each trait.

$$\text{Variance} = \frac{1}{(n - 1)} \left[ \sum (X_i - \bar{X})^2 \right]$$

Where,

$X_i$  = Individual value

$\bar{X}^2$  = Population mean

n = Number of observations

Standard deviation (SD) =  $\sqrt{\text{Variance}}$

### 3.6.2 Estimation of genetic parameters

#### 3.6.2.1 Genotypic, phenotypic and environmental variances

Variance due to genotype, phenotype and environment was computed as follows.

$$\text{Genotypic variance } (\sigma^2_g) = \frac{\text{Treatment MSS} - \text{Error MSS}}{r}$$

Environmental variance ( $\sigma^2_e$ ) = Error mean sum of squares

Phenotypic variance ( $\sigma^2_p$ ) =  $\sigma^2_g + \sigma^2_e$

Where, 'r' is a number of replications.

### 3.6.2.2 Genotypic and phenotypic coefficient of variation

Genotypic and phenotypic coefficients of variance were estimated according to Burton and Devane (1953) based on an estimate of genotypic variance (GV) and phenotypic variance (PV).

The genotypic coefficient of variation (GCV)

$$\text{GCV (\%)} = \frac{\sigma_g}{\bar{x}} \times 100$$

The phenotypic coefficient of variation (PCV)

$$\text{PCV (\%)} = \frac{\sigma_p}{\bar{x}} \times 100$$

Where,

$\bar{x}$  = Grand mean

r = Number of replications

$\sigma_g$  = Genotypic standard deviation

$\sigma_p$  = Phenotypic standard deviation

PCV and GCV were classified (Subramaniyan and Memon, 1973) as mentioned below

<10 %	Low
10-20 %	Moderate
>20 %	High

### 3.6.2.3 Heritability

The broad sense heritability ( $h^2$ ) was estimated by following the procedure suggested by Weber and Moorthy (1952) as indicated here below.

$$h^2 = \frac{\sigma^2_g}{\sigma^2_p} \times 100$$

Where,

$h^2$  (%) = Heritability (Broad sense)

$\sigma^2_g$  = Genotypic variance

$\sigma^2_p$  = Phenotypic variance

Heritability was categorized (Robinson *et al.*, 1949) as mentioned below

<30 %	Low
30-60 %	Moderate
>60 %	High

#### 3.6.2.4 Expected genetic advance

Genetic advance for each character was predicted by the formula given by Johnson *et al.* (1955).

$$GA = h^2 \times \sigma_p \times k$$

Where,

k = selection differential at 5 per cent selection intensity

$h^2$  = Heritability in broad sense

$\sigma_p$  = Phenotypic standard deviation

#### 3.6.2.5 Genetic advances as percentage of mean (GAM) calculated by:

$$GAM = \frac{GA}{\bar{X}} \times 100$$

Where,

GA = genetic advance.

$\bar{X}$  = general mean

The genetic advance as per cent of mean was categorized as suggested by Johnson *et al.* (1955) and the same is given below.

Genetic advance as % mean (GAM %)	Category
0-10 %	Low
11-20 %	Moderate
21 % and above	High

### 3.6.3 Correlation coefficient analysis

The correlation coefficient among all possible character combinations at phenotypic (p) and genotypic (g) level were estimated employing formula (Al-Jibouri *et al.*, 1958).

$$\text{Phenotypic correlation} = r_{xy}(P) = \frac{\text{Cov}_{xy}(p)}{\sqrt{V_x(p) \times V_y(p)}}$$

$$\text{Genotypic correlation} = r_{xy}(G) = \frac{\text{Cov}_{xy}(g)}{\sqrt{V_x(g) \times V_y(g)}}$$

Where,

$\text{Cov}_{xy}(g)$  = Genotypic covariance between x and y

$\text{Cov}_{xy}(p)$  = Phenotypic covariance between x and y

$V_x(g)$  = Genotypic variance of character 'x'

$V_x(p)$  = Phenotypic variance of character 'x'

$V_y(g)$  = Genotypic variance of character 'y'

$V_y(p)$  = Phenotypic variance of character 'y'

The test of significance for the association between characters was done by comparing table 'r' values at (n-2) error degrees of freedom for phenotypic and genotypic correlations with estimated values, respectively.

### 3.6.4 Path coefficient analysis

Path coefficient analysis suggested by Wright (1921) and Dewey and Lu (1959) was carried out to know the direct and indirect effect of the morphological traits on plant yield. The following set of simultaneous equations were formed and solved for estimating various direct and indirect effects.

$$r_{1y} = a + r_{12}b + r_{13}c + \dots + r_{1i}i$$

$$r_{2y} = a + r_{21}a + b + r_{23}c + \dots + r_{2i}i$$

$$r_{3y} = r_{31}a + r_{32}b + c + \dots + r_{3i}i$$

$$r_{1y} = r_{11}a + r_{12}b + r_{13}c + \dots + I$$

Where,

$r_{1y}$  to  $I_{iy}$  = Coefficient of correlation between causal factors 1 to I with dependent characters y.

$r_{12}$  to  $r_{1I}$  = Coefficient of correlation among causal factors

a, b, c,.....i = Direct effects of characters 'a' to 'I' on the dependent character 'y'

Residual effect (R) was computed as follows.

$$\text{Residual effect (R)} = 1 - \sqrt{a^2 + b^2 + c^2 + \dots + i^2 + 2abc_{12} + 2acr_{13} \dots}$$

## 4. EXPERIMENTAL RESULTS

The results of present investigation on “Evaluation of orange fleshed sweet potato (*Ipomoea batatas* L.) genotypes” was carried out at Regional Horticultural Research and Extension Centre (RHREC), Kumbapur, Dharwad, during *rabi* season 2020-2021 with view to find out the degree of mean performance, genetic variability for growth parameters, yield parameters, quality parameters, correlation, path analysis, storage studies and incidence of weevil infestation. The obtained data was subjected to statistical analysis to get the information regarding genetic variability among sixteen genotypes.

The results of the experiment are presented under following sub headings.

- 4.1 Analysis of variance
- 4.2 Mean performance of genotypes
- 4.3 Genetic variability studies
- 4.4 Correlation coefficient analysis
- 4.5 Path coefficient analysis

### 4.1 Analysis of variance

The analysis of variance for different quantitative and qualitative characters of sixteen genotypes of orange fleshed sweet potato was presented in Table 2 and 3. The analysis of variance indicated significantly higher amount of variability among the genotypes for all the characters studied *viz.*, vine length, number of branches per vine, number of leaves per vine, leaf area, internodal length, number of tubers per vine, tuber length, tuber girth, mean tuber weight, tuber yield per vine, tuber yield per plot, tuber yield per hectare, starch content, beta-carotene and dry matter content indicates the existence of enough amount of variability in all the traits under study.

**Table 2. Analysis of variance (mean sum of squares) for growth parameters in orange fleshed sweet potato genotypes**

Sl. No.	Source of variation/characters	Replication	Genotypes	Error	S.Em±	CD @ 5%
	Degrees of freedom	2	15	30		
<b>A</b>	<b>Growth parameters</b>					
1	Vine length (cm) at 60 DAP	255.87	1096.36*	172.13	7.57	21.87
2	Vine length (cm) at 90 DAP	282.80	1574.51*	203.94	8.24	23.81
3	Vine length (cm) at 120 DAP	423.52	1229.40*	366.06	11.04	31.9
4	Leaf area (cm <sup>2</sup> ) at 60 DAP	367262.09	2947601.11*	111174.23	192.50	555.99
5	Leaf area (cm <sup>2</sup> ) at 90 DAP	28821.18	34626000.04*	165514.82	234.88	678.39
6	Leaf area (cm <sup>2</sup> ) at 120 DAP	619507.00	7019614.08*	237667.58	281.46	812.92
7	Inter nodal length (cm) at 60 DAP	0.37	0.94*	0.11	0.19	0.56
8	Inter nodal length (cm) at 90 DAP	0.25	0.91*	0.08	0.17	0.49
9	Inter nodal length (cm) at 120 DAP	0.20	0.86*	0.09	0.18	0.52
10	Number of leaves per vine at 60 DAP	216.74	2678.75*	153.29	7.14	20.64
11	Number of leaves per vine at 90 DAP	233.16	2463.16*	315.40	10.25	29.61
12	Number of leaves per vine at 120 DAP	324.01	7002.10*	495.26	12.84	37.10
13	Number of branches per vine at 90 DAP	0.19	0.43*	0.07	0.15	0.46
14	Number of branches per vine at 120 DAP	0.55	0.93*	0.17	0.24	0.69

\* Significant @ 5 %

DAP: Days after planting

**Table 3. Analysis of variance (mean sum of squares) for yield and quality parameters in orange fleshed sweet potato genotypes**

Sl. No.	Source of variation/characters	Replication	Genotypes	Error	S.Em±	CD @ 5%
	Degrees of freedom	2	15	30		
<b>B Yield parameters</b>						
1	Number of tubers per vine	0.19	0.99*	0.06	0.15	0.43
2	Tuber length (cm)	4.00	4.98*	1.30	0.65	1.90
3	Tuber girth (cm)	0.89	19.52*	2.20	0.85	2.47
4	Mean weight of tuber (g)	702.42	17151.27*	282.86	9.71	28.04
5	Tuber yield per vine (g)	9319.50	176725.19*	3612.13	34.69	100.21
6	Tuber yield per plot (kg/plot)	6.72	120.50*	2.89	0.98	2.83
7	Tuber yield per hectare (t/ha)	8.30	148.77*	3.57	1.09	3.15
<b>C Quality parameters</b>						
8	Starch content (%)	0.84	32.83*	0.27	0.30	0.87
9	Dry matter content (%)	0.18	27.99*	0.29	0.31	0.90
10	Beta-carotene (mg/100g)	0.10	21.20*	0.04	0.12	0.37

\* Significant @ 5%

## 4.2 Mean performance of genotypes

The result of the mean performance of sixteen orange fleshed sweet potato genotypes for different horticultural traits were discussed in this chapter and are presented in Table 4 to 10.

### 4.2.1 Growth parameters

The mean performance of sixteen orange fleshed sweet potato genotypes for various growth parameters were depicted in Table 4.

#### 4.2.1.1 Vine length (cm)

Vine length was recorded mainly at 60, 90 and 120 DAP. At 60 DAP vine length is ranged between 96.33 to 178.28 cm with an average value of 132.16 cm (Table 4). Genotype TSP 16-10 (96.33 cm) recorded shortest vine length whereas genotype TSP 16-6 (178.28 cm) recorded highest vine length followed by TSP 16-9 (158.06 cm) and BSP-23 (149 cm).

Average vine length at 90 days after planting was 172.12 cm, with a range of 130.46 cm to 218.93 cm (Table 4). Significantly superior vine length was recorded by TSP 16-6 (218.93 cm) followed by TSP 16-9 (207.07 cm). Whereas shortest vine length was noticed in TSP 16-3 (130.46 cm).

At 120 days interval, vine length was ranged between 175.06 cm to 252.46 cm (Table 4). Genotype TSP 16-10 recorded shortest vine length (175.06 cm) whereas genotype TSP 16-6 (252.46 cm) recorded highest vine length followed by genotype TSP 16-9 (241.13 cm).

#### 4.2.1.2 Number of leaves per vine

Number of leaves at 60 days after planting were ranged from 69.73 to 175.6 with, an average mean value of 122.05 (Table 4). Genotype TSP 16-3 (69.33) recorded lowest total leaves per vine whereas genotype TSP 16-9 (175.60) followed by TSP 16-6 (166.00) recorded maximum number of leaves.

Table 4. Mean performance of orange fleshed sweet potato genotypes for growth parameters

A	Parameter	Vine length (cm)			Number of leaves per vine			Leaf area (cm <sup>2</sup> )			Number of branches per vine		Internodal length (cm)		
		60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP
1	TSP 16-3	117.40	130.46	211.20	69.73	115.47	160.73	2311.23	3338.30	4940.33	3.20	5.40	2.87	3.21	4.35
2	TSP 16-5	119.66	158.13	185.20	70.33	101.13	134.93	2455.66	3486.33	4208.17	4.27	6.47	2.69	3.09	3.93
3	TSP 16-6	178.20	218.93	252.46	166.00	206.13	307.40	5476.17	6838.83	9852.56	4.66	6.50	2.55	2.69	2.79
4	TSP 16-7	125.46	157.33	184.53	119.93	172.47	209.27	4083.72	6085.13	7358.77	3.73	5.33	3.05	3.35	3.60
5	TSP 16-9	158.06	207.06	241.13	175.60	210.53	281.80	5510.96	6834.51	8770.25	4.07	4.93	2.93	3.19	3.39
6	TSP 16-10	96.33	153.06	175.06	111.40	144.60	169.73	2886.07	3870.71	4475.08	3.60	5.30	3.17	3.36	4.04
7	ST-14 (Bhu Sona)	135.53	195.86	226.40	128.87	170.40	210.27	3190.36	4162.13	4956.17	3.67	5.28	2.96	3.26	3.58
8	TSP 16-8	123.13	145.66	199.93	111.07	159.80	194.40	2993.89	4456.05	5499.10	3.53	5.42	4.01	4.36	4.59
9	TSP 16-4	133.93	176.13	199.80	127.40	158.20	192.33	3732.68	5068.13	5901.37	3.53	5.35	3.67	3.96	4.13
10	TSP 16-18	113.73	159.00	219.93	128.33	158.07	198.60	3892.51	4998.97	6307.83	3.73	5.27	3.57	3.92	4.07
11	TSP 16-19	138.20	185.46	208.40	128.27	160.13	198.67	3735.73	4656.37	5778.17	3.73	5.87	4.01	4.25	4.43
12	TSP 16-20	130.86	161.80	203.53	135.93	158.20	196.47	4260.60	5107.63	6320.80	3.87	5.13	3.84	4.19	4.37
13	TSP 16-21	138.80	176.00	211.73	111.13	161.93	194.93	2973.71	4383.07	5275.35	3.73	4.98	4.25	4.37	4.71
14	TSP 16-32	119.33	181.06	226.33	87.00	148.73	196.13	2098.54	3724.53	4621.47	3.47	5.53	3.85	4.12	4.29
15	TSP 16-36	136.93	181.40	209.66	124.47	156.67	211.13	3392.67	4376.13	5883.57	3.93	4.83	3.62	3.90	4.46
16	BSP-23 (Local Check)	149.00	166.66	208.40	157.33	199.53	306.27	3151.01	4103.89	6220.94	4.47	6.60	2.60	2.95	3.28
	<b>Mean</b>	<b>132.16</b>	<b>172.12</b>	<b>210.23</b>	<b>122.05</b>	<b>161.37</b>	<b>210.19</b>	<b>3509.09</b>	<b>4718.17</b>	<b>6023.11</b>	<b>3.82</b>	<b>5.51</b>	<b>3.35</b>	<b>3.63</b>	<b>4.00</b>
	<b>S.Em±</b>	7.57	8.24	11.04	7.14	10.25	12.84	192.50	234.88	281.46	0.15	0.24	0.19	0.17	0.18
	<b>C.D @ 5%</b>	21.87	23.81	31.90	20.64	29.61	37.10	555.99	678.39	812.92	0.46	0.69	0.56	0.49	0.52
	<b>CV (%)</b>	9.92	8.29	9.10	10.14	11.00	10.58	9.50	8.62	8.09	7.23	7.60	10.03	8.10	7.84

DAP= Days after planting

At 90 days after planting number of leaves ranges between 101.13 to 210.53. Genotype TSP 16-5 (101.13) recorded minimum total leaves per vine whereas genotype TSP 16-9 (210.53) recorded maximum number of leaves.

Average number of leaves per vine at 120 DAP was 210.19 with a range of 134.99 to 307.4 (Table 4). Genotype TSP 16-6 (307.4) recorded maximum total leaves per vine followed by BSP- 23 (306.27). Whereas TSP 16-5 (134.99) genotype recorded minimum number of leaves.

#### **4.2.1.3 Leaf area (cm<sup>2</sup>)**

At 60 DAP leaf area ranges between 2098.54 to 5510.95 cm<sup>2</sup>. Genotype TSP 16-32 (2098.54 cm<sup>2</sup>) recorded minimum leaf area whereas genotype TSP 16-9 (5510.95 cm<sup>2</sup>) recorded maximum leaf area. The average leaf area was estimated 3509.09 cm<sup>2</sup> among sixteen genotypes studied.

Leaf area at 90 DAP was ranged from 3338.3 to 6838.83 cm<sup>2</sup> and the average mean value was 4718.17 cm<sup>2</sup> Table (4). Significantly superior leaf area was recorded by TSP 16-6 (6838.83 cm<sup>2</sup>) followed by TSP 16-9 (6834.51). Whereas the minimum leaf area was noticed in TSP 16-3 (3338.3 cm<sup>2</sup>).

At 120 days after planting leaf area was ranged between 4208.17 to 9852.56 cm<sup>2</sup>. Average leaf area was found to be 6023.12 cm<sup>2</sup> among sixteen genotypes of orange fleshed sweet potato. Genotype TSP 16-5 (4208.17 cm<sup>2</sup>) recorded minimum leaf area whereas TSP 16-6 (9852.56 cm<sup>2</sup>) followed by TSP 16-9 (8770.25 cm<sup>2</sup>) recorded maximum leaf area.

#### **4.2.1.4 Number of branches per vine**

Number of branches per vine at 90 DAP ranged from 3.20 to 4.66 and the average mean value was 3.82 Table (4). Highest numbers of branches per vine were recorded in genotype TSP 16-6 (4.66) followed by BSP-23 (4.47). Whereas minimum number of branches were observed in genotype TSP 16-3 (3.20).

Maximum number of branches at 120 DAP were recorded in BSP-23 (6.60) followed by TSP 16-6 (6.50) which are statistically on par with genotype TSP 16-5

(6.47). Whereas minimum number of branches per vine were observed in TSP 16-36 (4.83) genotype.

#### **4.2.1.5 Internodal length (cm)**

Internodal length was recorded at 60 DAP ranges from 2.55 to 4.25 cm. Significantly superior internodal length was noticed by genotype TSP 16-21 (4.25 cm). Whereas shortest internodal length was observed in genotype TSP 16-6 (2.55 cm). The average internodal length was found to be 3.35 cm.

At 90 DAP internodal length was ranged between 2.69 to 4.37 cm. Genotype TSP 16-6 (2.69 cm) recorded shortest internodal length whereas genotype TSP 16-21 (4.37 cm) recorded highest internodal length. The average internodal length at 90 days after planting was found to be 3.63 cm.

Average internodal length at 120 DAP was 4.00 cm, with a range of 2.79 cm to 4.71 cm (Table 4). Genotype TSP 16-6 (2.79 cm) recorded shortest internodal length whereas TSP 16-21 (4.71 cm) recorded highest internodal length followed by TSP 16-8 (4.59 cm).

#### **4.2.2 Yield parameters**

The mean performance of sixteen orange fleshed sweet potato genotypes for various yield parameters were presented in Table 5.

##### **4.2.2.1 Number of tubers per vine**

The numbers of tuber per vine were ranged between 2.73 to 4.60 and the estimated average mean value was 3.23 (Table 5). The genotype TSP 16-6 showed highest number of tuberous roots per vine (4.60) followed by BSP-23 (4.33) while genotype TSP 16-10 recorded lowest number of tuberous roots per vine of about 2.73.

##### **4.2.2.2 Tuber length (cm)**

The average mean value for tuber length was found to be 12.50 cm with range of 10.94 to 15.60 cm. The highest length of tuber (15.60 cm) was recorded in genotype TSP 16-6 followed by BSP-23 (14.90 cm), whereas genotype ST-14 (10.94 cm) recorded lowest length of tuber.

Table 5. Mean performance of orange fleshed sweet potato genotypes for yield parameters

Genotypes		Number of tubers	Tuber length (cm)	Tuber girth (cm)	Mean weight of tuber (g)	Tuber yield per vine (g)	Tuber yield per plot (kg)	Tuber yield per hectare (t)
1	TSP 16-3	2.87	11.66	15.42	109.18	205.00	10.12	11.24
2	TSP 16-5	2.87	11.38	17.39	122.01	322.20	12.40	13.78
3	TSP 16-6	4.60	15.60	18.91	315.28	1027.87	33.65	37.39
4	TSP 16-7	3.33	12.82	18.28	170.43	680.53	20.66	22.96
5	TSP 16-9	3.93	13.69	18.75	311.78	941.27	26.64	29.60
6	TSP 16-10	2.73	12.05	13.50	150.72	461.07	14.41	16.01
7	ST-14 (Bhu Sona)	3.53	10.94	20.27	251.58	618.73	12.73	14.14
8	TSP 16-8	2.80	11.95	15.75	123.61	365.53	13.90	15.45
9	TSP 16-4	2.93	12.27	13.91	106.19	467.73	18.03	20.04
10	TSP 16-18	3.13	11.20	14.46	152.91	499.60	17.57	19.52
11	TSP 16-19	3.07	12.33	12.54	137.76	351.60	13.41	14.90
12	TSP 16-20	2.80	12.93	15.89	143.30	484.00	17.49	19.43
13	TSP 16-21	3.00	11.93	15.82	133.94	372.80	13.37	14.86
14	TSP 16-32	2.80	12.73	13.67	140.91	464.67	16.77	18.64
15	TSP 16-36	3.02	11.60	16.50	135.14	385.73	15.98	17.76
16	BSP-23(Local Check)	4.33	14.90	21.26	313.14	939.47	26.79	29.77
<b>Mean</b>		3.23	12.50	16.39	176.11	536.73	17.74	19.71
<b>S.Em±</b>		0.15	0.65	0.85	9.71	34.69	0.98	1.09
<b>C.D @ 5%</b>		0.43	1.90	2.47	28.04	100.21	2.83	3.15
<b>CV (%)</b>		8.14	9.13	9.05	9.54	11.19	9.59	9.59

#### **4.2.2.3 Tuber girth (cm)**

Among the genotypes significant variation was seen with respect to tuber girth with a range of 12.54 to 21.26 cm and the estimated average mean value was 16.39 cm (Table 5). Significantly maximum tuber girth was recorded in BSP-23 (21.26 cm). Whereas lowest tuber girth was noticed in TSP 16-19 (12.54 cm) genotype.

#### **4.2.2.4 Mean weight of tuber (g)**

A significant difference was observed between the genotypes for average mean weight of tuber with an overall mean of 176.11 g. The genotype TSP 16-6 (315.28 g) exhibited highest mean weight of tuber followed by BSP-23 (313.14 g) whereas minimum mean tuber weight was observed in TSP 16-4 (106.19 g) genotype.

#### **4.2.2.5 Tuber yield per vine (g)**

The tuber yield per vine ranges from 205 to 1027.87 g with an average value was found to be 536.73 g. The TSP 16-3 genotype recorded lowest tuber yield per vine (205 g) while genotype TSP 16-6 recorded highest tuber yield per vine (1027.87 g) followed by TSP 16-9 (941.27 g) and BSP-23 (939.47 g).

#### **4.2.2.6 Tuber yield per plot (kg)**

The significant difference was observed among the genotypes for tuber yield per plot and the average mean value recorded for tuber yield per plot was 17.74 kg (Table 5). The genotype TSP 16-6 (33.65 kg) recorded highest tuber yield per plot followed by BSP-23 (26.79 kg). Whereas lowest tuber yield per plot was observed in TSP 16-3 (10.12 kg) genotype.

#### **4.2.2.7 Tuber yield per hectare (t)**

The significant difference was observed between the genotypes for tuber yield per hectare (Table 5). It varied from 11.24 tonnes to 37.38 tonnes and the average mean value for tuber yield per hectare was 19.71 tonnes. Highest tuber yield per hectare was recorded by TSP 16-6 (37.39 t) and lowest tuber yield per hectare was observed in TSP 16-3 (11.24 t) genotype.

#### **4.2.2.8 Tuber damage by Weevil infestation (%)**

The significant differences were observed for weevil infestation among sixteen orange fleshed sweet potato genotypes (Table 6). It varied from 3 per cent to 11 per cent with an average mean of 14.29 per cent. The genotype TSP 16-19 showed the lowest incidence of weevil infestation (3 %). Whereas the percent of weevil incidence was highest in the genotype TSP 16-9 (11 %).

#### **4.2.3 Quality parameters**

The mean performance of sixteen orange fleshed sweet potato genotypes for various quality parameters were presented in Table 7.

##### **4.2.3.1 Starch content (%)**

The starch content in tuber was ranged between 12.91 per cent to 24.44 per cent and mean value was 17.95 per cent. The significantly highest starch content of 24.44 per cent was recorded in TSP 16-7 genotype. While BSP-23 genotype had showed lowest starch content in tuber of about 12.91 per cent.

##### **4.2.3.2 Beta carotene (mg/100g)**

Significant difference was observed amongst the genotypes for Beta carotene. ST-14 recorded significantly highest Beta carotene content of 13.12 (mg/100 g), followed by TSP 16-7 (6.91 mg/100 g) and TSP 16-5 (5.19 mg/100 g). Lowest beta carotene content in tuber was found to be 1.91 mg/100 g in TSP 16-20 genotype. The average mean value for Beta carotene was 4.33 (mg/100 g).

##### **4.2.3.3 Dry matter (%)**

Statistically significant differences were observed for dry matter percent amongst the genotypes with an average mean value of 25.27 per cent (Table 7). The total dry matter percent in tuber ranges from 21.65 per cent to 31.41 per cent. The genotype TSP 16-7 recorded maximum dry matter content (31.41 %) followed by TSP 16-3 (30.53 %) while BSP-23 genotype showed minimum dry matter percent in tuber of about 21.65 per cent.

**Table 6. Tuber damage (%) by sweet potato weevil infestation**

Sl. No	Genotypes	Tuber damage by Weevil infestation (%)
1	TSP 16-3	5 (12.88)
2	TSP 16-5	6 (14.15)
3	TSP 16-6	5 (12.88)
4	TSP 16-7	7 (15.32)
5	TSP 16-9	11 (19.32)
6	TSP 16-10	9 (17.40)
7	ST-14 (Bhu Sona)	10 (18.42)
8	TSP 16-8	6 (14.15)
9	TSP 16-4	5 (12.88)
10	TSP 16-18	4 (11.48)
11	TSP 16-19	3 (9.88)
12	TSP 16-20	9 (17.40)
13	TSP 16-21	5 (12.88)
14	TSP 16-32	5 (12.88)
15	TSP 16-36	4 (11.47)
16	BSP-23(Local Check)	7 (15.32)
	<b>Mean</b>	14.29
	<b>S.Em ±</b>	0.82
	<b>CD @ 5%</b>	2.36

**Table 7. Mean performance of orange fleshed sweet potato genotypes for quality parameters**

Sl. No	Genotypes	Starch content (%)	Beta-carotene (mg/100g)	Dry matter (%)
1	TSP 16-3	18.82	3.93	30.53
2	TSP 16-5	20.32	5.19	26.98
3	TSP 16-6	20.84	5.01	24.53
4	TSP 16-7	24.44	6.91	31.41
5	TSP 16-9	21.49	3.16	23.80
6	TSP 16-10	22.40	3.71	28.98
7	ST-14 (Bhu Sona)	20.69	13.12	28.80
8	TSP 16-8	15.99	4.07	23.42
9	TSP 16-4	15.39	3.73	23.36
10	TSP 16-18	15.40	3.99	21.85
11	TSP 16-19	15.09	2.05	23.94
12	TSP 16-20	15.90	1.91	23.79
13	TSP 16-21	15.93	3.36	23.43
14	TSP 16-32	15.86	3.72	24.07
15	TSP 16-36	15.85	3.38	23.84
16	BSP-23 (Local Check)	12.91	2.04	21.65
<b>Mean</b>		17.95	4.33	25.27
<b>S.Em±</b>		0.30	0.12	0.31
<b>C.D @ 5%</b>		0.87	0.37	0.90
<b>CV (%)</b>		2.93	5.14	2.15

#### 4.2.3.4 Physiological loss of weight (PLW)

The significant differences were observed among the treatments with respect to physiological loss of weight (Table 8). The minimum PLW at 4<sup>th</sup>, 8<sup>th</sup>, 12<sup>th</sup> and 16<sup>th</sup> day (2.01 %, 4.06 %, 6.75 % and 7.72 %, respectively) was recorded in genotype BSP-23. Whereas ST-14 recorded highest physiological loss of weight (9.53 %, 16.25 %, 23.66 % and 29.88 %) at 4<sup>th</sup>, 8<sup>th</sup>, 12<sup>th</sup> and 16<sup>th</sup> day respectively.

#### 4.2.3.5 Visible appearance (scores)

The significant difference was observed decreased order from day fifteen to thirty DAS for visible appearance (shape) of tubers. However, the genotypes TSP 16-9, TSP 16-10, TSP 16-18, BSP-23, TSP 16-20, TSP 16-32 and TSP 16-36 recorded good score (4.0) for visibility appearance on 15 DAS. However, the visibility values were not up to the mark after 30 DAS. Whereas genotype TSP 16-4 maintained the good score up to 3.7 for tuber shape followed by TSP 16-36 (3.3) on 30 DAS.

#### 4.2.3.6 Skin and flesh color (scores)

The acceptability scores for skin and flesh color of orange fleshed sweet potato genotypes given in Table 10. Genotype ST-14 (5.0) and TSP 16-36 (5.0) recorded excellent score for skin color at initial days. While at 15 DAS good score was noticed in genotype TSP 16-10 (3.67). Whereas, TSP 16-6 (3.33) and TSP 16-10 (3.33) reported good score up to the mark of after 30 DAS.

However, the higher score for flesh color was exhibited by TSP 16- 5 (5.0), TSP 16-7 (5.0) and ST-14 (5.0) at initial days. While at 15 DAS good score was recorded by genotype TSP 16-19 (4.67).

Whereas genotype TSP 16-8 (3.0) maintained good score up to 30 DAS. The overall acceptability score for skin and flesh color was found to be maximum in ST-14 (5.0).

**Table 8. Mean performance of orange fleshed sweet potato genotypes for physiological loss in weight (PLW) under ambient condition**

Sl. No.	Genotypes	4 <sup>th</sup> day	8 <sup>th</sup> day	12 <sup>th</sup> day	16 <sup>th</sup> day
1	TSP 16-3	4.95	12.44	17.53	24.19
2	TSP 16-5	2.71	12.45	20.77	23.36
3	TSP 16-6	2.21	10.80	11.90	14.42
4	TSP 16-7	2.80	6.15	8.60	16.05
5	TSP 16-9	4.92	6.42	7.67	8.25
6	TSP 16-10	4.30	11.74	18.91	23.04
7	ST-14 (Bhu Sona)	9.53	16.25	23.66	29.88
8	TSP 16-8	7.57	13.47	17.38	22.43
9	TSP 16-4	9.14	15.39	20.69	25.83
10	TSP 16-18	3.31	7.58	15.57	21.10
11	TSP 16-19	5.90	9.63	13.77	17.76
12	TSP 16-20	5.65	12.91	18.94	22.03
13	TSP 16-21	3.47	5.30	12.01	19.37
14	TSP 16-32	7.00	16.80	22.14	28.58
15	TSP 16-36	7.21	15.52	20.52	25.00
16	BSP-23 (Local Check)	2.01	4.06	6.75	7.72
<b>Mean</b>		5.17	11.14	16.05	20.56
<b>S.Em±</b>		0.784	1.209	1.066	1.041
<b>C.D @ 5%</b>		2.264	3.492	4.144	4.048

**Table 9. Effect of ambient storage on Tuber appearance (Scores) of different orange fleshed sweet potato genotypes**

Sl. No.	Genotypes	Visible appearance (Scores)	
		DAS	
		15	30
1	TSP 16-3	3.7	1.7
2	TSP 16-5	4.0	2.3
3	TSP 16-6	3.7	2.7
4	TSP 16-7	3.7	2.7
5	TSP 16-9	4.0	2.3
6	TSP 16-10	4.0	2.7
7	ST-14 (Bhu Sona)	3.3	1.3
8	TSP 16-8	3.3	3.0
9	TSP 16-4	3.7	3.7
10	TSP 16-18	4.0	3.0
11	TSP 16-19	3.0	2.3
12	TSP 16-20	4.0	2.7
13	TSP 16-21	3.7	2.0
14	TSP 16-32	4.0	2.0
15	TSP 16-36	4.0	3.3
16	BSP-23 (Local Check)	4.0	2.0
<b>Mean</b>		3.8	2.5

**DAS**- Days after storage

**Table 10. Effect of storage on flesh colour and skin colour in tubers of different orange fleshed sweet potato genotypes**

Sl. No.	Genotypes	Skin colour (Scores)			Flesh colour (scores)		
		DAS					
		0	15	30	0	15	30
1	TSP 16-3	4.33	3.33	3.00	4.67	3.67	2.67
2	TSP 16-5	4.33	3.33	3.00	5.00	4.00	2.67
3	TSP 16-6	4.00	3.67	3.33	4.67	2.67	2.33
4	TSP 16-7	4.00	2.33	2.33	5.00	3.67	2.00
5	TSP 16-9	4.67	2.67	2.67	4.33	3.00	2.33
6	TSP 16-10	4.33	3.67	3.33	4.67	2.67	2.00
7	ST-14 (Bhu Sona)	5.00	2.67	1.33	5.00	2.67	1.00
8	TSP 16-8	4.33	3.00	2.00	4.33	2.33	3.00
9	TSP 16-4	4.00	3.33	2.67	4.67	3.67	2.33
10	TSP 16-18	4.00	3.00	2.67	4.67	3.33	1.67
11	TSP 16-19	4.33	2.67	1.67	4.33	4.67	2.00
12	TSP 16-20	4.00	3.00	2.33	4.60	2.67	2.67
13	TSP 16-21	4.67	2.67	2.00	4.33	3.33	2.67
14	TSP 16-32	4.33	2.00	1.67	4.67	3.00	2.67
15	TSP 16-36	5.00	3.33	2.67	4.33	2.67	2.67
16	BSP-23 (Local Check)	4.33	3.00	2.67	4.67	2.33	2.33
	<b>Mean</b>	4.35	2.97	2.45	4.58	3.14	2.31

**DAS** - Days after storage

### 4.3 Genetic variability studies

The amount of variation for a trait among sixteen orange fleshed sweet potato genotypes were observed by computation of range, mean, genotypic variance (GV), phenotypic variance (PV), genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), broad sense heritability ( $h^2$ ), genetic advance (GA) and genetic advance as per cent of mean (GAM) for all the traits were presented under study in Table 11 and 12.

#### 4.3.1 Growth parameters

##### 4.3.1.1 Vine length (cm)

Vine length at 60 DAP ranged from 96.33 cm to 178.20 cm and the average mean value of vine length was 132.16 cm. The genotypic variance (GV) and phenotypic variances (PV) were 303.03 and 361.63, respectively. Moderate estimate of genotypic coefficient of variation (13.14 %) and phenotypic coefficient of variation (14.36 %) were observed. High heritability (83.80 %) was observed coupled with GAM (24.79 %) and GA (32.82) for this character (Table 11).

Vine length at 90 DAP ranged from 130.46 cm to 218.93 cm and the average mean value of vine length was 172.12 cm. The genotypic variance (GV) and phenotypic variances (PV) were 471.78 and 546.02, respectively. Moderate estimate of genotypic coefficient of variation (GCV) (12.60 %) and phenotypic coefficient of variation (PCV) (13.56 %) were observed. High heritability (86.40 %) was observed along with GAM (24.14 %) and GA (41.59) for this trait (Table 11).

Vine length at 120 DAP ranged from 175.06 cm to 252.46 cm and the average mean value of vine length was 201.23 cm. The genotypic variance (GV) and phenotypic variances (PV) were 278.81 and 411.08, respectively. Lower estimate of genotypic coefficient of variation (GCV) (7.95 %) and phenotypic coefficient of variation (PCV) (9.66 %) were observed. High heritability (67.82 %) was observed coupled with moderate genetic advance as per cent of mean (13.50 %) and genetic advance (GA) (28.32) for this character (Table 11).

**Table 11. Estimates of range, mean, components of variance, heritability and genetic advance for growth attributes in orange fleshed sweet potato genotypes**

Sl. No.	Character	Range	Mean	GV	PV	GCV (%)	PCV (%)	$h^2$ (%)	GA	GAM %
<b>A</b>	<b>Growth parameter</b>									
1	Vine length (cm) 60 DAP	96.33-178.20	132.16	303.03	361.63	13.14	14.36	83.80	32.82	24.79
2	Vine length (cm) 90 DAP	130.46-218.93	172.12	471.78	546.02	12.60	13.56	86.40	41.59	24.14
3	Vine length (cm) 120 DAP	175.06-252.46	201.23	278.81	411.08	7.95	9.66	67.82	28.32	13.50
4	Number of leaves per vine 60 DAP	69.73-175.60	122.05	841.81	892.91	23.77	24.48	94.28	58.03	47.54
5	Number of leaves per vine 90 DAP	101.13-210.53	161.37	715.92	821.05	16.58	17.75	87.20	51.46	31.89
6	Number of leaves per vine 120 DAP	134.93-307.40	210.19	2168.94	2334.03	22.15	22.98	92.93	92.48	43.99
7	Leaf area (cm <sup>2</sup> ) 60 DAP	2098.54-5510.95	3509.09	945475.62	982533.70	27.70	28.24	96.23	1964.91	55.99
8	Leaf area (cm <sup>2</sup> ) 90DAP	3338.3-6838.83	4718.17	1099028.40	1154200.01	22.21	22.77	95.22	2107.34	44.66
9	Leaf area (cm <sup>2</sup> ) 120 DAP	4208.17-9852.56	6023.11	2260648.83	2339871.36	24.96	25.39	96.61	3044.41	50.54
10	Number of branches per vine 90 DAP	3.20-4.66	3.82	0.12	0.14	9.06	9.97	82.47	0.64	16.95
11	Number of branches per vine 120 DAP	4.83-6.60	5.51	0.25	0.31	9.09	10.10	81.09	0.93	16.87
12	Inter nodal length (cm) 60 DAP	2.55-4.25	3.35	0.27	0.31	15.70	16.73	88.01	1.01	30.34
13	Inter nodal length (cm) 90 DAP	2.69-4.37	3.63	0.27	0.30	14.47	15.21	90.53	1.03	28.36
14	Inter nodal length (cm) 120 DAP	2.79-4.70	4.00	0.25	0.28	12.61	13.40	88.59	0.97	24.46

**GV**- Genotypic variance;

**GCV**- Genotypic co- efficient of variation;

**DAP**- Days after planting

**PCV**- Phenotypic co-efficient of variation

**GA**- Genetic advance

**PV** - Phenotypic variance;

**GAM**- Genetic advance as percent mean

#### 4.3.1.2 Number of leaves per vine

Number of leaves at 60 DAP observed from 69.73 to 175.60 with an average mean of 122.05. The genotypic variance and phenotypic variance (PV) were 841.81 and 892.91, respectively. The estimates of genotypic coefficient of variation (23.77 %) and phenotypic coefficient of variation (24.48 %) were high with high heritability (94.28 %) along with high GAM (47.54 %) and GA (58.03) for this trait.

At 90 DAP number of leaves ranged from 101.13 to 210.53 with an average mean was found to be 161.37. The genotypic variance (GV) and phenotypic variances (PV) were 715.92 and 821.05 respectively. The estimates of genotypic coefficient of variation (16.58 %) and phenotypic coefficient of variation (17.75 %) were moderate with high heritability (87.20 %) coupled with GAM (31.89 %) and GA (51.46) for this trait.

The average mean for the character number of leaves at 120 DAP was 210.19 and ranged from 134.93 to 307.40. The genotypic variance (GV) and phenotypic variances (PV) were 2168.94 and 2334.03, respectively. The estimates of genotypic coefficient of variation (22.15 %) and phenotypic coefficient of variation (22.98 %) were high with high heritability (92.93 %) coupled with high GAM (43.99 %) and GA (92.48) for this trait.

#### 4.3.1.3 Leaf area (cm<sup>2</sup>)

Leaf area at 60 DAP observed from 2098.54 (cm<sup>2</sup>) to 5510.95 (cm<sup>2</sup>) with an average mean value of 3509.09 (cm<sup>2</sup>). The GV and PV were 945475.62 and 982533.70, respectively. The character had shown high level of genotypic coefficient of variation (27.7 %) and phenotypic coefficient of variation (28.24 %) with high heritability (96.23 %) coupled with GAM (55.99 %) and GA (1964.91) for this trait.

Leaf area at 90 DAP ranges from 3338.3 (cm<sup>2</sup>) to 6838.83 (cm<sup>2</sup>) with an average mean value of 4718.17 (cm<sup>2</sup>). The GV and PV were 1099028.40 and 1154200.01, respectively. The character had shown high level genotypic coefficient of variation

(22.21 %) and phenotypic coefficient of variation (22.77 %) with high heritability (95.22 %) coupled with GAM (44.66 %) and GA (2107.34) for this trait.

The average mean value for the character leaf area at 120 DAP was 6023.11 (cm<sup>2</sup>) and varied from 4208.17 (cm<sup>2</sup>) to 9852.56 (cm<sup>2</sup>). The genotypic variance (GV) and phenotypic variances (PV) were 2260648.83 and 2339871.36, respectively. The estimates of genotypic coefficient of variation (GCV) (24.96 %) and phenotypic coefficient of variation (PCV) (25.39 %) were high with high level of heritability (96.61 %) coupled with high level of genetic advance as per cent of mean (50.54 %) and GA (3044.41) for this trait.

#### **4.3.1.4 Number of branches per vine**

At 90 DAP number of branches varied from 3.20 to 4.66 with a grand mean was found to be 3.82. The estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were low (9.06 % and 9.97 % respectively). The GV and PV were 0.12 and 0.14, respectively. Higher level heritability (82.47 %) was observed coupled with moderate level of genetic advance as per cent of mean (16.95 %) and GA (0.64) for this trait.

Number of branches at 120 DAP ranged from 4.83 to 6.60 with average mean value of 5.51. The genotypic variance (0.25) and phenotypic variance (0.31) observed for number of branches. The character had showed low level of genotypic coefficient of variation (9.09 %) and moderate level of phenotypic coefficient of variation (10.10 %) and exhibited high level of heritability (81.09 %) coupled with moderate level of GAM (16.87 %) and GA (0.93) for the character.

#### **4.3.1.5 Internodal length (cm)**

At 60 DAP internodal length was observed from 2.55 cm to 4.25 cm with grand mean 3.35 cm. The GV and PV were 0.27 and 0.31, respectively. The character had shown moderate level of genotypic coefficient of variation and phenotypic coefficient of variation of 15.70 % and 16.73 % respectively. The character exhibited high heritability (88.01 %) coupled with GAM (30.34 %) and genetic advance (1.01) for this character.

The internodal length at 90 DAP varied from 2.69 cm to 4.37 cm at 90 DAP with a mean value of 3.63. The genotypic variance (GV) and phenotypic variances (PV) were 0.27 to 0.30, respectively. The moderate level of genotypic coefficient of variation (14.47 %) and moderate level of phenotypic coefficient of variation (15.21 %) with high level of heritability (90.53 %) coupled with higher level of genetic advance as per cent of mean (28.36 %) and GA (1.03) for this trait.

Average mean value for the character internodal length at 120 DAP was found 4.00 and it varies from 2.79 cm to 4.70 cm. The genotypic variance (GV) (0.25) and phenotypic variance (PV) (0.28) recorded for number of branches. The estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were moderate (12.61 % and 13.40 % respectively). High heritability (88.59 %) was observed coupled with GAM (24.46 %) and GA (0.97) for this trait.

### **4.3.2 Yield parameters**

#### **4.3.2.1 Number of tubers per vine**

The number of tubers per vine is having grand mean of 3.23. Number of tubers per vine is ranged from 2.73 - 4.60. The GV and PV were 0.30 and 0.33, respectively. Number of tubers per vine has exhibited a moderate level of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) found to be 17.80 per cent each. High heritability (93.02 %) was observed coupled with GAM (34.12 %) and GA (1.10).

#### **4.3.2.2 Tuber length (cm)**

Tuber length ranged from 10.94 cm to 15.60 cm with a mean value of 12.49 cm. The GV and PV were 1.22 and 1.66, respectively. The low estimates of genotypic coefficient of variation (GCV) and moderate estimate of phenotypic coefficient of variation (PCV) (8.86 % and 10.31 %, respectively). High heritability (73.87 %) was observed coupled with moderate genetic advance as per cent of mean (15.69 %) and GA (1.96).

#### **4.3.2.3 Tuber girth (cm)**

Tuber girth ranged from 12.54 cm to 21.26 cm with an average mean value of 16.39 cm. The GV and PV were 5.77 and 6.50, respectively. The estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were moderate (14.65 % and 15.55 % respectively). The high heritability (88.71 %) was observed coupled with the GAM (28.43 %) and GA was 4.66 (Table 12).

#### **4.3.2.4 Mean weight of tuber (g)**

Mean weight of tuber was ranged from 106.19-315.27 g with average value of 176.11 g. The GV and PV were 5622.80 and 5717.09 respectively. The estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were high (42.57 % and 42.93 %, respectively). The high heritability (98.35 %) was observed coupled with GAM (86.98 %) and GA was 153.19 (Table 12).

#### **4.3.2.5 Tuber yield per vine (g)**

Total tuber yield per vine had shown a higher variation ranging from 205-1027.86 g with a grand mean value of 536.73 g. The GV and PV were 57704.35 and 58908.39, respectively. The estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were high (44.75 % and 45.21 %, respectively). The high heritability (97.96 %) was observed coupled with GAM (91.24 %) and GA was 489.76 (Table 12).

#### **4.3.2.6 Tuber yield per plot (kg)**

Total tuber yield per plot was ranged between 10.11 kg to 33.64 kg. Mean yield per plant was 17.74 kg. The GV and PV were 39.20 and 40.16, respectively. The estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were high (35.28 % and 35.71 % respectively). The high heritability (97.60 %) was observed coupled with the GAM (71.80 %) and GA was 12.74 (Table 12).





**Table 12. Estimates of range, mean, components of variance, heritability and genetic advance for yield and quality attributes in orange fleshed sweet potato genotypes**

Sl. No.	Character	Range	Mean	GV	PV	GCV (%)	PCV (%)	$h^2$ (%)	GA	GAM %
<b>B</b>	<b>Yield parameter</b>									
1	Number of tubers per vine	2.73-4.60	3.23	0.30	0.33	17.80	17.80	93.02	1.10	34.12
2	Tuber length (cm)	10.94-15.60	12.49	1.22	1.66	8.86	10.31	73.87	1.96	15.69
3	Tuber girth (cm)	12.54-21.26	16.39	5.77	6.50	14.65	15.55	88.71	4.66	28.43
4	Mean weight of tuber (g)	106.19-315.27	176.11	5622.80	5717.09	42.57	42.93	98.35	153.19	86.98
5	Tuber yield per vine (g)	205-1027.86	536.73	57704.35	58908.39	44.75	45.21	97.96	489.76	91.24
6	Tuber yield per plot (kg/plot)	10.11-33.64	17.74	39.20	40.16	35.28	35.71	97.60	12.74	71.80
7	Tuber yield per hectare (t/ha)	11.24-37.38	19.71	48.39	49.59	35.28	35.71	97.60	14.15	71.80
<b>C</b>	<b>Quality parameter</b>									
1	Starch content (%)	12.91-24.44	17.95	10.85	10.94	18.34	18.42	99.15	6.75	37.63
2	Dry matter content (%)	21.65-31.41	25.27	9.23	9.33	12.01	12.08	98.94	6.22	24.62
3	Beta-carotene (mg/100g)	1.91-13.11	4.33	7.05	7.06	61.31	61.38	99.77	5.46	126.15

**GV-** Genotypic variance

**PCV-** Phenotypic co-efficient of variation

**PV -** Phenotypic variance

**GCV-** Genotypic co- efficient of variation

**GA-**Genetic advance

**GAM-**Genetic advance as percent mean

#### **4.3.2.7 Tuber Yield per hectare (t/ha)**

Total tuber yield per hectare was ranged between 11.24 tonnes to 37.38 tonnes with mean value of 19.71 tonnes. The GV and PV were 48.39 and 49.59 respectively. The estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were high (35.28 % and 35.71 % respectively). The high heritability (97.60 %) was observed coupled with the high genetic advance as per cent of mean (71.80 %) and genetic advance (GA) was 14.15 (Table 12).

#### **4.3.3 Quality parameters**

##### **4.3.3.1 Starch content (%)**

The minimum and maximum values for starch content of tuber were 12.91 per cent and 24.44 per cent respectively with an average mean value of 17.95 per cent. The GV and PV were 10.85 and 10.94 respectively. The estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were moderate (18.34 and 18.42 %, respectively). Very high heritability (99.15 %) was observed along with high genetic advance as per cent of mean (37.63 %) and GA (6.75) (Table 12).

##### **4.3.3.2 Dry matter (%)**

The minimum and maximum values for dry matter percent of tuber were 21.65 per cent to 31.41 per cent with an average mean of 25.27 per cent. The GV and PV were 9.23 and 9.33 respectively. The estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were moderate (12.01 % and 12.08 %, respectively). Very high heritability (98.94 %) was observed coupled with high genetic advance as per cent of mean (24.62 %) and genetic advance (GA) was 6.22 (Table 12).

##### **4.3.3.3 Beta-carotene (mg/100g)**

The beta-carotene content of tuber ranged from 1.91 mg/100 g to 13.11 mg/100 g. Average mean value for this trait was found to be 4.33 mg/100 g. The estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were high (61.31 % and 61.38 %, respectively). The character having very high heritability (99.77 %) with high genetic advance as per cent of mean (126.15 %) and GA was 5.46 (Table 12).

## 4.4 Correlation studies

Correlation coefficient measures the degree of association between different yield components either in positive or negative direction. The correlation studies were carried out to know the nature and direction of association existing between growth parameters, yield parameters and quality parameters of orange fleshed sweet potato genotypes. The genotypic and phenotypic correlation coefficients were worked out for ten characters and are represented in Table 13 and 14, respectively.

### 4.4.1 Genotypic correlation

Genotypic correlation coefficients among growth and yield attributes are presented in Table 13.

#### 4.4.1.1 Association of tuber yield per vine V/s component traits

From the Table 13, it was observed that tuber yield per vine exhibited highly significant and positive association with number of tubers per vine (0.960), mean tuber weight (0.957), total leaves per vine at 90 DAP (0.951), length of tuber (0.942), number of branches per vine at 90 DAP (0.794), leaf area at 90 DAP (0.738), tuber girth (0.745), vine length at 90 DAP (0.679), number of branches per at genotypic level whereas, it had highly significant negative association with internodal length at 90 days after planting (-0.635).

#### 4.4.1.2 Association among component traits

Vine length at 90 days after planting was highly significant and positive association with number of leaves per vine at 90 DAP (0.786), tuber weight (0.704), number of tubers per vine (0.699), tuber yield per vine (0.679), leaf area at 90 DAP (0.666), number of branches per vine at 90 DAP (0.615) and length of tuber (0.544). It also showed positive and significant correlation with tuber girth (0.350) but it showed non-significant and negative association with internodal length (-0.252).

Number of branches at 90 DAP showed positive and highly significant correlation with length of tuber (0.960), number of tubers per vine (0.926), tuber yield per vine (0.794), tuber girth (0.780), tuber weight (0.770), internodal length at 90 DAP (0.666), number of leaves at 90 DAP (0.649) and leaf area at 90 DAP (0.509).

**Table 13. Estimates of genotypic correlation coefficients for growth and yield parameters in orange fleshed sweet potato genotypes**

	1	2	3	4	5	6	7	8	9	10
1	<b>1.000</b>	0.615**	0.786**	-0.252	0.666**	0.699**	0.544**	0.350*	0.704**	0.679**
2		<b>1.000</b>	0.649**	0.666**	0.509**	0.926**	0.960**	0.780**	0.770**	0.794**
3			<b>1.000</b>	-0.251	0.772**	0.876**	0.812**	0.549**	0.902**	0.951**
4				<b>1.000</b>	-0.247	-0.717**	0.542**	-0.752**	-0.697**	-0.635**
5					<b>1.000</b>	0.634**	0.697**	0.300 **	0.569**	0.738**
6						<b>1.000</b>	0.879**	0.821**	0.992**	0.960**
7							<b>1.000</b>	0.490**	0.858**	0.942**
8								<b>1.000</b>	0.821**	0.745**
9									<b>1.000</b>	0.957**
10										<b>1.000</b>

**\*Significant at p= 0.05 \*\*Significant at p= 0.01**

\*\* Significant at 1% (0.368) level of Significance \* Significant at 5% (0.284) level of Significance

1 - Vine length (cm) at 90 DAP

5- Leaf area (cm<sup>2</sup>) at 90 DAP

9- Mean weight of tuber (g)

2 - No. of branches per vine at 90 DAP

6- No. of tubers /vine

10- Tuber yield / vine (g)

3 - No of leaves / vine at 90 DAP

7- Tuber length (cm)

4 - Inter nodal length (cm) at 90 DAP

8- Tuber girth (cm)

Number of leaves per vine at 90 DAP was positively and highly significantly associated with tuber yield per vine (0.951), tuber weight (0.902), number of tubers per vine (0.876), length of tuber (0.812), leaf area at 90 DAP (0.722) and tuber girth (0.549) but it was negatively and significantly associated with internodal length (-0.251).

Internodal length at 90 DAP showed positive and highly significantly correlation with tuber length (0.542). Whereas, it showed highly significant negative correlation with tuber girth (-0.752), number of tubers per vine (-0.717), tuber weight (-0.697) and tuber yield per vine (-0.635). It also showed non-significant negative correlation with leaf area at 90 DAP (-0.247).

Leaf area at 90 DAP was highly significant and positively correlated with tuber yield per vine (0.738), length of tuber (0.697), number of tuber per vine (0.634), mean weight of tuber (0.569) and tuber girth (0.300).

Number of tubers per vine exhibited highly significant and positive correlation with mean weight of tuber (0.992), tuber yield per vine (0.960), length of tuber (0.879) and tuber girth (0.821).

The estimates of correlation for tuber length were positive and highly significantly correlated with tuber yield per vine (0.942), mean weight of tuber (0.858) and tuber girth (0.490).

The estimates of correlation for tuber girth showed positive and highly significant correlation with mean tuber weight (0.821) and tuber yield per vine (0.745).

Average tuber weight exhibited positive and highly significant correlation with tuber yield per vine (0.957).

#### **4.4.2 Phenotypic correlation**

Phenotypic correlation coefficients among growth and yield attributes are presented in Table 14.

#### 4.4.2.1 Association of tuber yield per vine V/s component traits

From the Table 14, it was observed that at phenotypic level, tuber yield per vine exhibited significant and positive association with tuber weight (0.939), number of tubers per vine (0.919), number of leaves per vine at 90 DAP (0.877), length of tuber (0.813), number of branches at 90 DAP (0.709), leaf area at 90 DAP (0.707), tuber girth (0.692) and vine length at 90 DAP (0.637). But character had negative and highly significant association with internodal length (-0.601).

#### 4.2.2.2 Association among component traits

The estimates of correlation for vine length at 90 DAP was highly significant and positive correlation with total leaves per vine at 90 DAP (0.676), tuber weight (0.646), tuber yield per vine (0.637), number of tubers per vine (0.631), leaf area at 90 DAP (0.597), number of branches at 90 DAP (0.530) and length of tuber (0.466) and it also showed positive and significant correlation with tuber girth (0.319). But it showed negative non-significant correlation with internodal length (-0.208).

Number of branches at 90 DAP was positive and highly significantly association with number of tubers per vine (0.764), tuber yield per vine (0.709), mean tuber weight (0.697), length of tuber (0.682), tuber girth (0.628), number of leaves per vine at 90 DAP (0.506) and leaf area at 90 DAP (0.438). However negative and highly significant correlation with internodal length at 90 DAP (-0.550).

The estimates of correlation for total leaves per vine at 90 days after planting was positively and highly significantly correlated with total tuber yield per vine (0.877), tuber weight (0.820), number of tubers per vine (0.802), leaf area at 90 DAP (0.755), length of tuber (0.717) and tuber girth (0.509). But it was negatively and non-significantly correlated with internodal length at 90 DAP (-0.221).

Internodal length at 90 days after planting showed significant but negative correlation with number of tubers per vine (-0.675), tuber girth (-0.674), mean tuber weight (-0.663), tuber yield per vine (0.601) and length of tuber (-0.445), but it showed negative and non significant association with leaf area at 90 DAP (-0.207).

**Table 14. Estimates of phenotypic correlation coefficients for growth and yield parameters in orange fleshed sweet potato genotypes**

	1	2	3	4	5	6	7	8	9	10
1	<b>1.000</b>	0.530**	0.676**	-0.208	0.597**	0.631**	0.466**	0.319*	0.646**	0.637**
2		<b>1.000</b>	0.506**	-0.550**	0.438**	0.764**	0.682**	0.628**	0.697**	0.709**
3			<b>1.000</b>	-0.221	0.755**	0.802**	0.717**	0.509**	0.820**	0.877**
4				<b>1.000</b>	-0.207	-0.675**	-0.445**	-0.674**	-0.663**	-0.601**
5					<b>1.000</b>	0.588**	0.576**	0.291*	0.545**	0.707**
6						<b>1.000</b>	0.782**	0.753**	0.942**	0.919**
7							<b>1.000</b>	0.431**	0.718**	0.813**
8								<b>1.000</b>	0.772**	0.692**
9									<b>1.00</b>	0.939**
10										<b>1.000</b>

\*Significant at p= 0.05 \*\*Significant at p= 0.01

\*\* Significant at 1% (0.368) level of Significance \* Significant at 5% (0.284) level of Significance

1 - Vine length (cm) at 90 DAP

5 - Leaf area (cm<sup>2</sup>) at 90 DAP

9- Mean weight of tuber (g)

2 - No. of branches per vine at 90 DAP

6- No. of tubers /vine

10- Tuber yield / vine (g)

3 - No of leaves /vine at 90 DAP

7- Tuber length (cm)

4 - Inter nodal length (cm) at 90 DAP

8- Tuber girth (cm)

Leaf area at 90 days after planting was highly significant and positively correlated with tuber yield per vine (0.707), number of tubers per vine (0.588), length of tuber (0.576), mean weight of tuber (0.545) and tuber girth (0.291). It also showed positive and significant correlation with tuber girth (0.291).

Number of tubers per vine was highly significant and positively correlated with tuber mean weight (0.942), tuber yield per vine (0.919), length of tuber (0.782) and tuber girth (0.753).

The estimates of correlation for tuber length were highly significant and positively correlated with tuber yield per vine (0.813), mean weight of tuber (0.718) and tuber girth (0.431).

Tuber girth was highly significant and positively correlation with tuber weight (0.772) and tuber yield per vine (0.692).

Average tuber weight was showed positive and highly significant correlation with tuber yield per vine (0.939).

## **4.5 Path coefficient analysis**

The results of path coefficients give comparative contribution of different traits towards tuber yield per vine. By partitioning the phenotypic and genotype correlations, the direct effect of a chosen trait on tuber yield per vine and its indirect effects through other characters were computed and presented in Table 15 and Table 16.

### **4.5.1 Genotypic path coefficient analysis for tuber yield per vine**

Genotypic path coefficients for total tuber yield per vine with nine independent characters are presented in Table 15.

Vine length at 90 days after planting showed negative direct effect (-0.6081) on tuber yield per vine ( $r_G = 0.6798$ ) and it had positive indirect effects through number of tubers per vine (2.2731), leaf area at 90 DAP (0.0907), total leaves per vine at 90 DAP (0.1313). The negative indirect effects *via* number of branches at 90 DAP (-0.0566), internodal length at 90 DAP (-0.0286), length of tuber (-0.3902), tuber girth (-0.2859) and mean weight of tuber (-0.4459).

Number of branches at 90 DAP exhibited negative direct effect (-0.0919) on tuber yield per vine ( $rG = 0.7942$ ) and it had its positive indirect effects through number of tubers per vine (3.0092), leaf area at 90 DAP (0.0693) and total leaves per vine (0.1084). The negative indirect effects *via* vine length at 90 DAP (-0.3742), internodal length at 90 DAP (-0.0754), length of tuber (-0.7275), tuber girth (-0.6361) and tuber weight (-0.4876).

Number of leaves per vine at 90 DAP exhibited positive direct effect (0.1669) on tuber yield per vine ( $rG = 0.9514$ ) and it had positive indirect effects through leaf area at 90 DAP (0.105), number of tubers per vine (2.8476). Whereas the negative indirect effect through vine length at 90 DAP (-0.4781), number of branches per vine at 90 DAP (-0.0597), internodal length at 90 DAP (-0.0285), length of tuber (-0.5827), tuber girth (-0.448) and mean tuber weight (-0.5713).

Internodal length at 90 DAP showed positive direct effect (0.1133) on tuber yield per vine ( $rG = -0.6353$ ). The positive indirect effects *viva*, vine length at 90 DAP (0.1536) and number of branches per vine at 90 DAP (0.0612), length of tuber (0.389), tuber girth (0.6128) and tuber weight (0.4415). However negative indirect effects through total leaves per vine (-0.0419), leaf area at 90 DAP (-0.0336) and number of tubers per vine (-2.3311).

Leaf area at 90 DAP (0.136) exhibited positive direct effect on tuber yield per vine ( $rG = 0.7388$ ). Whereas positive indirect effect through total leaves per vine at 90 DAP (0.1289) and number of tubers per vine (2.0602) was recorded. It also exhibited negative indirect effect through vine length at 90 DAP (-0.04056), number of branches per vine at 90 DAP (-0.0468) and internodal length (-0.028) at 90 DAP.

Number of tubers per vine showed positive direct effect (3.2487) on tuber yield per vine ( $rG = 0.9609$ ). The positive indirect effects *via*, total leaves per vine at 90 DAP (0.1463), leaf area at 90 DAP (0.0863) was observed. The negative indirect effects through vine length at 90 DAP (-0.4255), number of branches at 90 DAP (-0.0852), internodal length at 90 DAP (-0.0813), length of tuber (-0.6304), tuber girth (-0.6697) and mean weight of tuber (-0.6284).

**Table 15. Estimates of genotypic path coefficients for growth, yield and quality parameters in orange fleshed sweet potato genotypes**

	1	2	3	4	5	6	7	8	9	10
1	<b>-0.6081</b>	-0.0566	0.1313	-0.0286	0.0907	2.2731	-0.3902	-0.2859	-0.4459	0.6798**
2	-0.3742	<b>-0.0919</b>	0.1084	-0.0754	0.0693	3.0092	-0.7275	-0.6361	-0.4876	0.7942**
3	-0.4781	-0.0597	<b>0.1669</b>	-0.0285	0.105	2.8476	-0.5827	-0.448	-0.5713	0.9514**
4	0.1536	0.0612	-0.0419	<b>0.1133</b>	-0.0336	-2.3311	0.389	0.6128	0.4415	-0.6353**
5	-0.4056	-0.0468	0.1289	-0.028	<b>0.1360</b>	2.0602	-0.5001	-0.2451	-0.3607	0.7388**
6	-0.4255	-0.0852	0.1463	-0.0813	0.0863	<b>3.2487</b>	-0.6304	-0.6697	-0.6284	0.9609**
7	-0.331	-0.0933	0.1357	-0.0615	0.0949	2.8572	<b>-0.7168</b>	-0.399	-0.5434	0.942**
8	-0.2133	-0.0718	0.0918	-0.0852	0.0409	2.67	-0.3518	<b>-0.8149</b>	-0.52	0.7458**
9	-0.4284	-0.0708	0.1507	-0.079	0.0775	3.2252	-0.6154	-0.6695	<b>-0.6329</b>	0.9573**

**R SQUARE = 0.9338 RESIDUAL EFFECT= 0.2572 Diagonal values indicates direct effect**

**\*Significant at p= 5 %      \*\*Significant p=1 %**

1 - Vine length (cm) at 90 DAP

5 - Leaf area (cm<sup>2</sup>) at 90 DAP

9 - Mean weight of tuber (g)

2 - No. of branches per vine at 90 DAP

6 - No. of tubers/vine

10 - Tuber yield / vine (g)

3- No of leaves/vine at 90 DAP

7 – Tuber length (cm)

4 – Inter nodal length (cm) at 90 DAP

8 – Tuber girth (cm)

Tuber length showed negative direct effect (-0.7168) on tuber yield per vine ( $r_G = 0.942$ ) and it had positive indirect effects through number of leaves at 90 DAP (0.1357), leaf area at 90 DAP (0.0949), total tubers per vine (2.67). The negative in direct effects *via* vine length at 90 DAP (-0.331), number of branches at 90 DAP (-0.0933), inter nodal length at 90 DAP (-0.0615), tuber girth (-0.399) and mean tuber weight (-0.5434) was observed.

Tuber girth possesses negative direct effect (-0.8149) on tuber yield per vine ( $r_G = 0.7458$ ) and it had its positive indirect effects through total leaves per vine at 90 DAP (0.0918), leaf area at 90 DAP (0.0409), total tubers per vine (2.67). It also observed that negative indirect effects mainly through vine length at 90 DAP (-0.2133), number of branches at 90 DAP (-0.0718), internodal length at 90 DAP (-0.0852), length of tuber (-0.3518) and mean weight of tuber (-0.52) was recorded.

Tuber weight showed negative direct effect (-0.6329) on tuber yield per vine ( $r_G = 0.9573$ ) and it had positive indirect effect through total leaves per vine at 90 DAP (0.1507), leaf area at 90 DAP (0.0775) and total tubers per vine (3.2252). It also observed that negative indirect effects mainly through vine length at 90 DAP (-0.4284), number of branches at 90 DAP (-0.0708), internodal length at 90 DAP (-0.079), length of tuber (-0.6154) and tuber girth (-0.6695).

#### **4.5.2 Phenotypic path coefficient analysis for tuber yield per vine**

Phenotypic path coefficients for total tuber yield per vine with 9 independent characters are presented in Table in 16.

Among sixteen different characters studied, vine length at 90 DAP had direct negative effect (-0.004) on tuber yield per vine ( $r_P = 0.637$ ). Positive indirect effect was noticed through number of branches per vine at 90 DAP (0.058), total leaves per vine at 90 DAP (0.352), internodal length at 90 DAP (0.061), leaf area at 90 DAP (0.068), length of tuber (0.074), tuber girth (0.01) and mean weight of tuber (0.208). Whereas Negative, indirect effect was noticed through total tubers per vine (-0.184).

Number of branches at 90 DAP had positive direct effect (0.109) on tuber yield per vine ( $rP=0.709$ ) and it had its positive indirect effects through total leaves per vine at 90 DAP (0.263), internodal length at 90 DAP (0.162), leaf area at 90 DAP (0.044), length of tuber (0.021), tuber girth (0.021) and mean weight of tuber (0.225). The negative indirect effects *via* vine length at 90 DAP (-0.002) and total tubers per vine (-0.223) was observed.

Number of leaves per vine at 90 DAP exhibited positive direct effect (0.521) on tuber yield per vine ( $rP=0.877$ ) and it had positive indirect effects through number of branches at 90 DAP per vine (0.055), internodal length at 90 DAP (0.065), leaf area at 90 DAP (0.077), length of tuber (0.114), tuber girth (0.017) and tuber weight (0.264). Whereas the negative indirect effect through vine length at 90 DAP (-0.003) and total tubers per vine (-0.233) was recorded.

Inter nodal length at 90 DAP showed negative direct effect (-0.294) on tuber yield per vine ( $rP= -0.601$ ). However it had positive indirect effects *via*, vine length at 90 DAP (0.001) and number of tubers per vine (0.197). It also had negative indirect effects through number of branches per vine at 90 DAP (-0.060), total leaves per vine (-0.115) and leaf area at 90 DAP (-0.021), length of tuber (-0.071), tuber girth (-0.022) and tuber weight (-0.214).

Leaf area at 90 DAP (0.707) had positive direct effect on tuber yield per vine ( $rP= 0.101$ ). It had its positive indirect effect through number of branches (0.047) at 90 DAP, total leaves per vine at 90 DAP (0.393), internodal length at 90 DAP (0.061), length of tuber (0.092), tuber girth (0.010) and mean weight of tuber (0.176). Whereas it had negative indirect effect through vine length at 90 DAP (-0.002) and number of tubers per vine (-0.171).

Number of tubers per vine had negative direct effect ( $rP= -0.2916$ ) on tuber yield per vine (0.9195). It also had positive indirect effects through number of branches per vine at 90 DAP (0.0835), total leaves per vine at 90 DAP (0.4179), internodal length at 90 DAP (0.199), leaf area at 90 DAP (0.0599), length of tuber (0.1249), tuber girth (0.0249) and mean weight of tuber (0.232). Whereas vine length at 90 DAP (-0.0031) showed negative indirect effects on tuber yield per vine).

**Table 16. Estimates of phenotypic path coefficients for growth and yield parameters in orange fleshed Sweet potato genotype**

	1	2	3	4	5	6	7	8	9	10
1	<b>-0.004</b>	0.058	0.352	0.061	0.068	-0.184	0.074	0.01	0.208	0.637**
2	-0.002	<b>0.109</b>	0.263	0.162	0.044	-0.223	0.108	0.021	0.225	0.709**
3	-0.003	0.055	<b>0.521</b>	0.065	0.077	-0.233	0.114	0.017	0.264	0.877**
4	0.001	-0.060	-0.115	<b>-0.294</b>	-0.021	0.197	-0.071	-0.022	-0.214	-0.601**
5	-0.002	0.047	0.393	0.061	<b>0.101</b>	-0.171	0.092	0.010	0.176	0.707**
6	-0.0031	0.0835	0.4179	0.199	0.0599	<b>-0.2916</b>	0.1249	0.0249	0.3042	0.919**
7	-0.0023	0.0745	0.3739	0.1314	0.0587	-0.2282	<b>0.1596</b>	0.0143	0.232	0.813**
8	-0.0016	0.0686	0.2653	0.1988	0.0297	-0.2196	0.0689	<b>0.033</b>	0.2495	0.692**
9	-0.0032	0.0762	0.4273	0.1955	0.0555	-0.2747	0.1147	0.0255	<b>0.3229</b>	0.939**

**R SQUARE = 0.9686 RES IDUAL EFFECT = 0.1771      Diagonal values indicate direct effect**

**\*Significant at p= 5 %      \*\*Significant p=1 %**

1 - Vine length (cm) at 90 DAP

5 - Leaf area (cm<sup>2</sup>) at 90 DAP

9 - Mean weight of tuber (g)

2 - No. of branches per vine at 90 DAP

6 - No. of tubers/vine

10 - Tuber yield / vine (g)

3- No of leaves/vine at 90 DAP

7 – Tuber length (cm)

4 – Inter nodal length (cm) at 90 DAP

8 – Tuber girth (cm)

Tuber length had showed positive direct effect ( $rP=0.1596$ ) on tuber yield per vine (0.8139) and it also had positive indirect effects through number of branches per vine at 90 DAP (0.0745), total leaves per vine at 90 DAP (0.3739), internodal length at 90 DAP (0.1314), leaf area at 90 DAP (0.0587), tuber girth (0.0143) and mean tuber weight (0.232). Tuber length showed negative indirect effects *via* vine length at 90 DAP (- 0.0023) and total tubers per vine (-0.2282).

Tuber girth exhibited positive direct effect ( $rP=0.033$ ) on total tuber yield per vine (0.6927) and it also had its positive indirect effects through number of branches per vine at 90 DAP (0.0686), number of leaves at 90 DAP (0.2653), internodal length (0.1988), leaf area at 90 DAP (0.0297), length of tuber (0.0689) and mean weight of tuber (0.2495). Tuber girth showed negative indirect effects mainly through vine length at 90 DAP (-0.0016) and total tubers per vine (-0.2196).

Tuber weight showed positive direct effect ( $rP=0.322$ ) on tuber yield per vine (0.9396) and it also recorded positive indirect effects through number of branches at 90 DAP (0.0762), number of leaves at 90 DAP (0.4273), internodal length at 90 DAP (0.1955), leaf area at 90 DAP (0.0555), length of tuber (0.1147), tuber girth (0.0255). But vine length at 90 DAP (-0.0032) and total tubers per vine (-0.2747) had negative indirect effects on tuber yield per vine.

## 5. DISCUSSION

Sweet potato is one of the important popular tuber crops grown throughout India. The area is concentrated mostly in Orissa, Bihar, West Bengal, Uttar Pradesh and Maharashtra. While reviewing the breeding aspect of sweet potato, it was observed that no systematic work has been made to improve this crop for developing new varieties with desirable characters like high yield, vigorous in growth with less spreading, high percentage of medium, moderately chunky roots of uniform shape and size, resistance to pest and diseases and wide adoption. Sexual method is now cheaply used in development of superior varieties. Hence, the first and foremost important step in breeding for improvement of yield and its component characters is to assess the genetic variability in available germplasm, which will be of immense value to design a selection procedure and to identify the superior genotypes. The pace and quantum of genetic improvement through selection or hybridization followed by selection can be determined by degree of genetic variability.

In the present investigation, attempts were made to assess the genetic variability and performance of orange fleshed sweet potato genotypes for their growth, yield and quality characteristics was conducted during 2020-2021 and the results of the experiments were discussed in this chapter under the following headings

- 5.1 Genetic variability, heritability, genetic advance and genetic advance as per cent of mean
- 5.2 Character association
- 5.3 Path analysis
- 5.4 Quality parameter and weevil infestation

### **5.1 Genetic variability, heritability and genetic advance for growth, Yield and quality parameters**

In present experiment sixteen orange fleshed sweet potato genotypes were studied to evaluate their genetic potential. Analysis of variance showed that mean performance with respect to all genotypes were considerable highly significant for all

the traits studied. This also been exemplified by mean values for these characters, which indicated that, the genotypes under study were genetically diverse for growth yield and quality parameters in present investigation.

The amount of variation for a trait among sixteen orange fleshed sweet potato genotypes were judged by estimation of range, mean, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in broad sense and estimated genetic advance as per cent mean (GAM) are presented for all the characters under study in Table 11 and 12.

The range in the values reflects the amount of phenotypic variability which is very reliable, since it includes genotypic, environmental and genotypic x environmental interaction components and does not reveal as to which character is showing higher degree of variability. Further, the phenotype of the crop is influenced by additive gene action (heritable), dominance (non- heritable) and epistasis (non-allelic interaction). Hence, it becomes necessary to split the observed variability into phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV), which ultimately indicates the extent of variability existing for various traits. As such, even this cannot give exact picture about the amount of inheritance of the trait. Therefore, the heritability of a trait is relied upon, as it aids the plant breeder to choose the level of selection pressure to be applied under specific environment, which separates the influence of the environment from the total variability. However, its usage would be limited as this is sensitive to environmental changes, experimental materials *etc.* The assessment of heritability has prime role in determining the efficacy of selection of a character provided, it is considered in combination with the estimated genetic advance (GA) as suggested by Johnson *et al.* (1955) and Panse and Sukhatme (1957). Heritability is influenced by type of biometrical method used, hybrid generation, sample size and the surrounding environment. With this background, the outcomes of the present study are discussed in this chapter.

The analysis of variance (Table 2 and 3) revealed highly significant variations among the lines for all the characters *viz.*, vine length, number of branches per vine, number of leaves per vine, leaf area, internodal length, tuber length, tuber girth, mean weight of tuber, tuber yield per vine, tuber yield per plot, tuber yield per hectare, starch

content, dry matter percent and beta carotene at  $P=0.01$ . This indicates that sufficient variability had existed for the characters studied and considerable improvement could be achieved by selection. However, the analysis of variance by itself is not enough and conclusive to explain all the inherent genotypic variances in the advanced genotypes. One of the ways to assess the variability in these characters is through a simple approach of examining the range of variations. Range of variation observed for all the traits in the present study indicated the presence of sufficient amount of variation among the advanced lines for all the characters studied.

The phenotypic and genotypic coefficient of variation was calculated for all the characters (Table 11 and 12). The result revealed that phenotypic coefficient of variance was in general higher than the genotypic coefficient of variance for all the characters. It is due to presence of substantial influence of environmental factors besides the genetic variation for expression of these traits.

### **5.1.1 Growth parameters**

In the present study high (>20 %) magnitude of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were observed for leaf area at 60 DAP, 90 DAP and 120 DAP and total leaves per vine at 60 DAP and 120 DAP. Indicating wider range of variability exhibited in this trait (Table 11). Similar results were also obtained by Badu *et al.* (2017) for leaf area in orange fleshed sweet potato. Singh *et al.* (2015) for number of leaves in sweet potato. It indicated the presence of high variability in the genotypes for selection. The differences between phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) values were minimum for most of the traits studied and indicating that, traits under study were less influenced by environment. Hence, these characters can be relied upon and simple selection can be practiced for further improvement.

The moderate phenotypic coefficient of variations (PCV) and genotypic coefficient of variations (GCV) were recorded for other growth parameters like vine length at 60 DAP and 90 DAP, total leaves per vine at 90 DAP and inter nodal length at 60 DAP, 90 DAP and 120 DAP. Indicates that the apparent variation is not only due to genotypes but also due to the little influence of environment on the expression of character. Similar opinion was expressed by other researchers like Rangare and Rangare

(2013), Singh *et al.* (2015), Darshan *et al.* (2017), Sharavati *et al.* (2018) and Gehan *et al.* (2019).

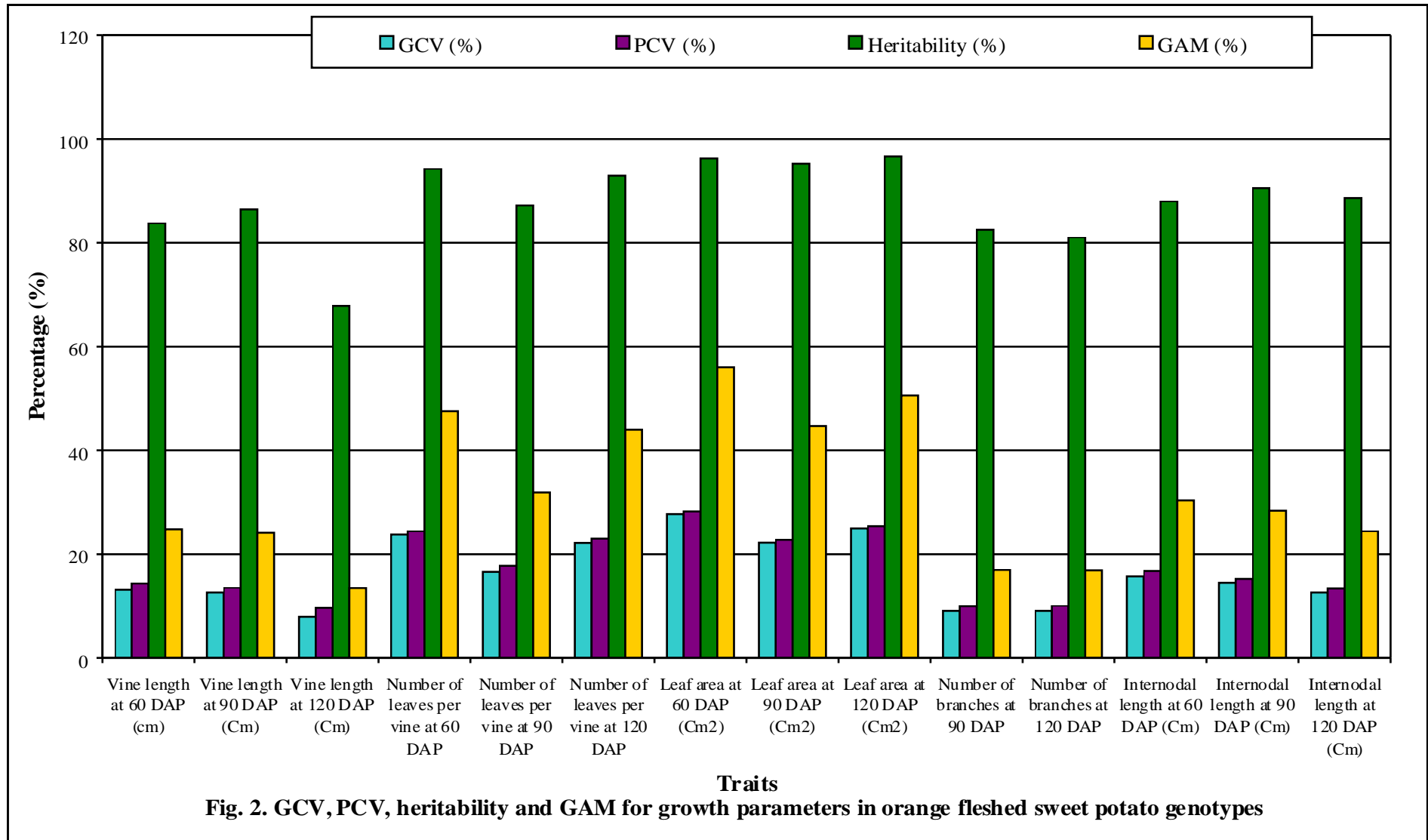
High heritability (> 60%) coupled with high genetic advance as per cent of mean (GAM) (>20%) were recorded for growth parameters such as vine length at 60 and 90 DAP, leaf area, total leaves per vine and internodal length at 60, 90 and 120 DAP respectively. These results suggested that the inheritance of such traits governed mainly by additive gene effects hence selection based on phenotypic performance may be performed useful (Table 11). As high heritability accompanied with high genetic advance as per cent mean indicates the prevalence of additive gene action, selection would be effective. Similar results were noticed in earlier studies by Prarthana *et al.* (2015) for vine length, internodal length, number of leaves and leaf area index in sweet potato, Badu *et al.* (2017) for vine length, number of leaves, internodal length Ramachandra and Srinivasa (2017), for leaf area in sweet potato, Sharavati *et al.* (2018) in vine length, number of leaves, internodal length in sweet potato, Narasimhamurthy *et al.* (2018) for vine length and leaf area in orange fleshed sweet potato.

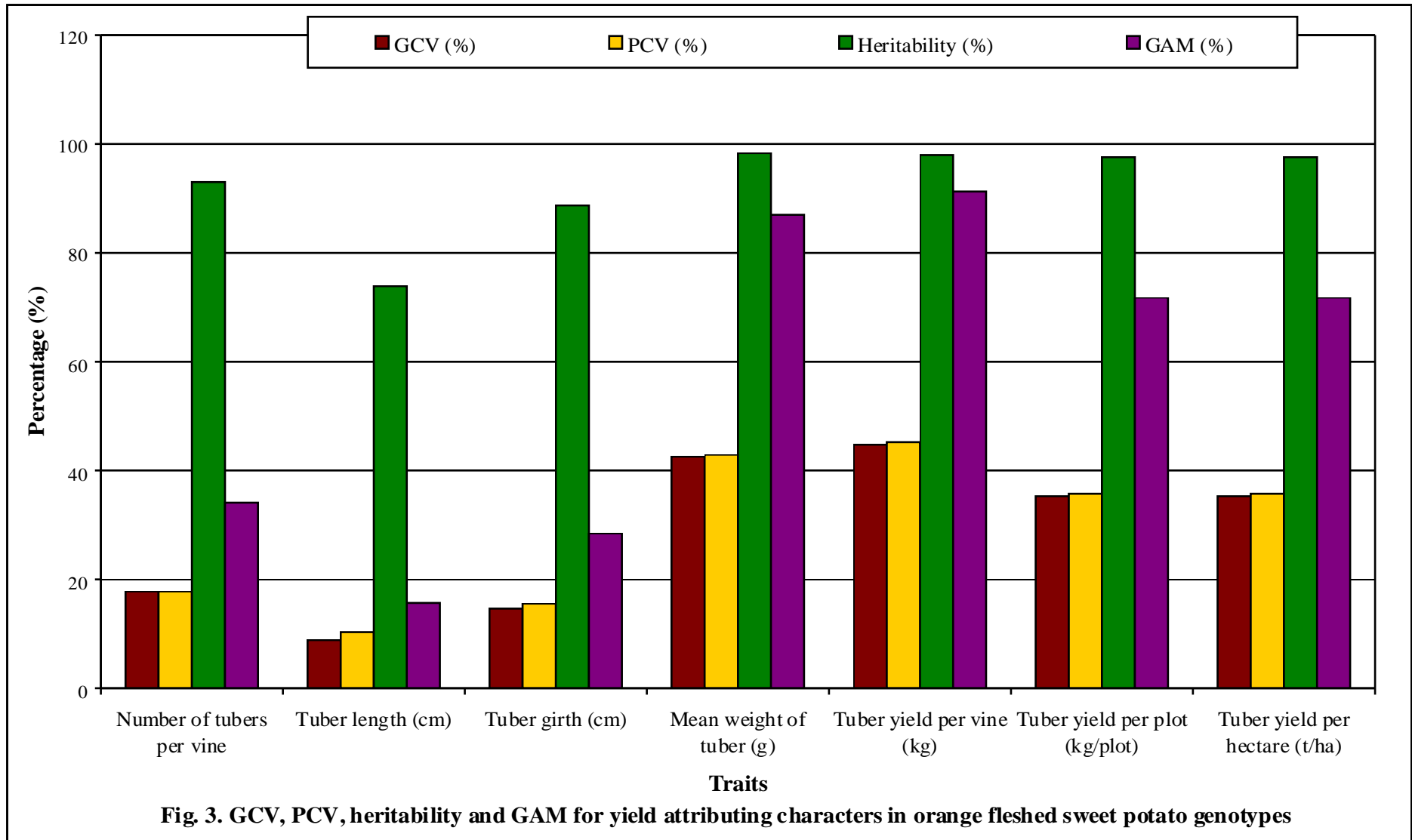
High heritability with moderate genetic advance as per cent mean were observed for number of branches at per vine 90 DAP and 120 DAP (Fig. 2). This shows the role of non additive gene action. Similar results were obtained by Madawal *et al.* (2015) in Sweet potato genotypes.

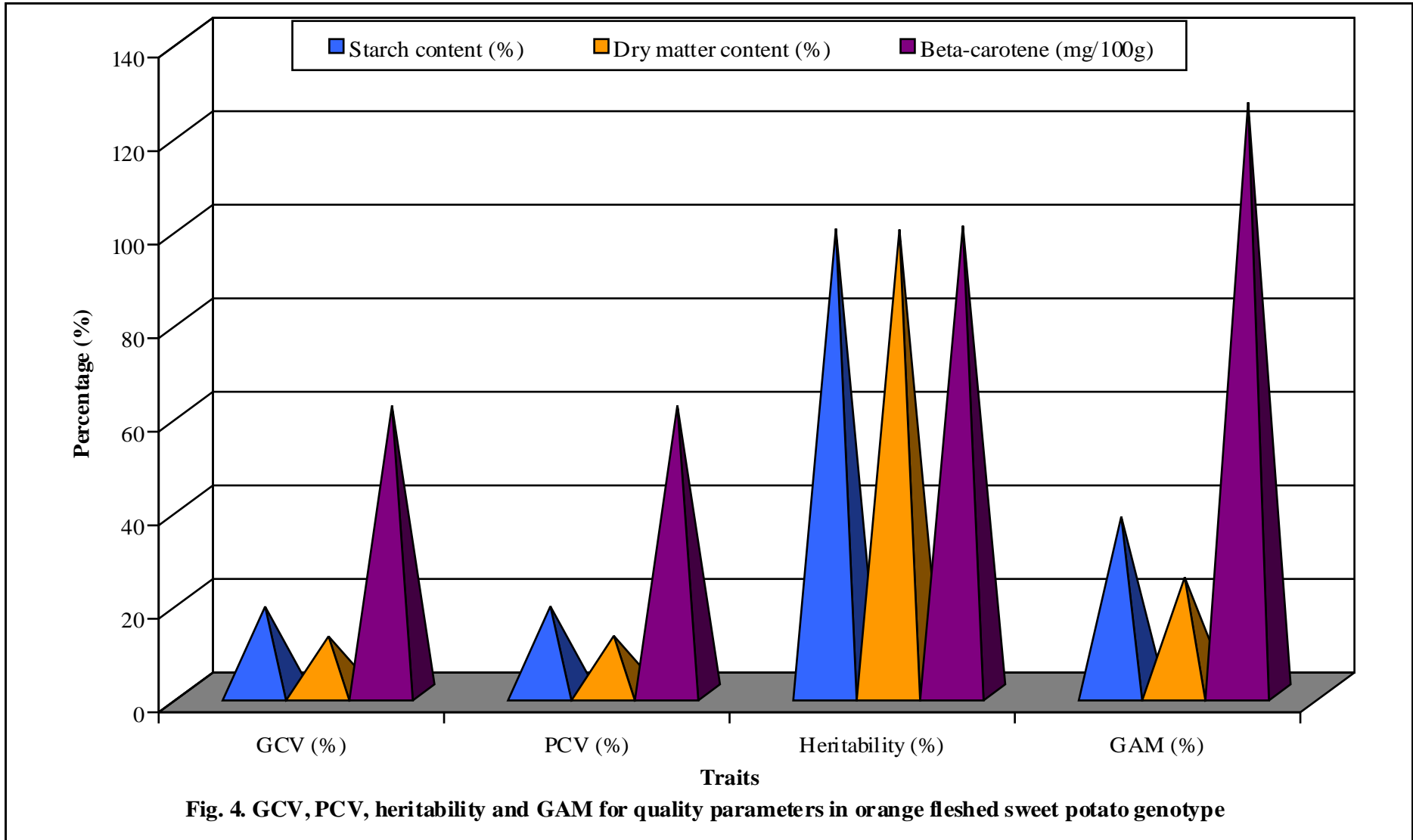
### 5.1.2 Yield attributing parameters

High estimates of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) (>20%) were recorded for yield attributing characters like mean weight of tuber, yield of tubers per vine, yield of tubers per plot, yield of tubers per hectare (Fig 3). The differences between phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were minimum. Indicating that, traits under study were less influenced by environment. Similar results also found by Prarthana *et al.* (2015), Tripura *et al.* (2016), Badu *et al.* (2017), Panigrahi *et al.* (2017), Sharavati *et al.* (2018).

Moderate genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) (11-20%) were observed for total tubers per vine and tuber girth indicating moderate variability for these traits in the genetic stock. These findings are in







close agreement with the results obtained by Gin *et al.* (2008) and Darshan *et al.* (2017), Sharavati *et al.* (2018), Gehan *et al.* (2019).

High heritability (>60%) coupled with high genetic advance as per cent of mean (GAM) (>20%) were noticed for most of the yield attributing characters such as number of tubers per vine, girth of tuber, tuber mean weight, yield of tubers per vine, yield of tubers per plot, yield of tubers per hectare indicating predominance of additive gene component. Thus, there is an ample scope for improving these characters by direct selection. Similar results were also reported by Nasiruddin *et al.* (2014), Madawal *et al.* (2015), Badu *et al.* (2017), Ramachandra and Srinivasa (2017), Sharavati *et al.* (2018) for traits total tubers per vine, tuber girth, mean weight of tuber, tuber yield per vine, tuber yield per plot, tuber yield per hectare in sweet potato. For tuber yield per vine, tuber yield per plot, results were similar to Tripathi (2016) and Narasimhamurthy *et al.* (2018). The research findings of Gehan *et al.* (2019), Prajapati *et al.* (2020) and Seid *et al.* (2020) was similar for number of tubers per plant.

### 5.1.3 Quality parameters

In general, the phenotypic coefficients of variation (PCV) were found to be slightly higher than genotypic coefficient of variation (GCV) for most of the quality attributing traits, which shows the minor influence of environment in the expression of these traits.

Estimates of high phenotypic coefficient of variation and genotypic coefficient of variation (>20%) were recorded for beta carotene content of tuber. Similar results were also observed by Badu *et al.* (2017), Narasimhamurthy *et al.* (2018), Sharavati *et al.* (2018).

In the present investigation, high heritability coupled with high genetic advance as per cent over mean (GAM) was recorded for most of the quality traits such as beta carotene, starch percent and dry matter indicated that the characters with the high heritability along with high genetic advance can be considered for direct selection for improvement. These results are similar with findings of earlier researchers like, Badu *et al.* (2017), Mekonnen *et al.* (2021) recorded for beta carotene in sweet potato, Tripathi (2016) for dry matter percent in sweet potato Ramchandra and srinivas (2017) for starch (Fig. 4).

## 5.2 Correlation studies

Good amount of variation in quantitative characters provide basis for selection in breeding programme. The knowledge of association between different characters and yield helps the breeder to sort out the characters associated with yield.

The phenotypic correlation coefficients specify the degree of the observed relationship between two characters. It includes hereditary as well as environmental influences so that this does not give exact genetic depiction of the relationships. Genotypic correlation includes only hereditary influences and it provides an estimate of inherent association between genes controlling any two characters. Hence forth, it is of greater significance and could be effectively used in formulating an effective selection scheme. Therefore, in the present investigation, the genotypic and phenotypic correlation coefficients were worked out.

In the present investigation narrow difference between the phenotypic and genotypic correlation coefficients was recorded for many characters and this shows that less environmental influence in the expression of these characters and presence of strong inherent association among the characters. To estimate the association between two variables, correlation coefficient at phenotypic and genotypic levels, was worked out in all possible combination and presented in Table 13 and 14.

From the table 13 and 14, it was noticed that tuber yield per vine showed positive and highly significant association for vine length at 90 DAP, total leaves per vine at 90 DAP, number of branches per vine at 90 DAP, leaf area at 90 DAP, total tubers per vine and tuber weight. It has shown positive and significant phenotypic and genotypic association *via* tuber girth at both the levels. While internodal length at 90 DAP showed negative and non significant association with tuber yield per vine. Similar findings were observed by Padma *et al.* (2009), Jha (2012), Rao *et al.* (2017), Panigrahi *et al.* (2017) and Mekonnen *et al.* (2020).

At both genotypic and phenotypic level, vine length at 90 DAP was positively and highly significant ( $p=0.01$ ) correlation with number of branches per vine at 90 DAP, total leaves per vine at 90 DAP, leaf area at 90 DAP, number of tubers per vine, length of tuber, tuber weight and tuber yield per vine. It also showed positive and

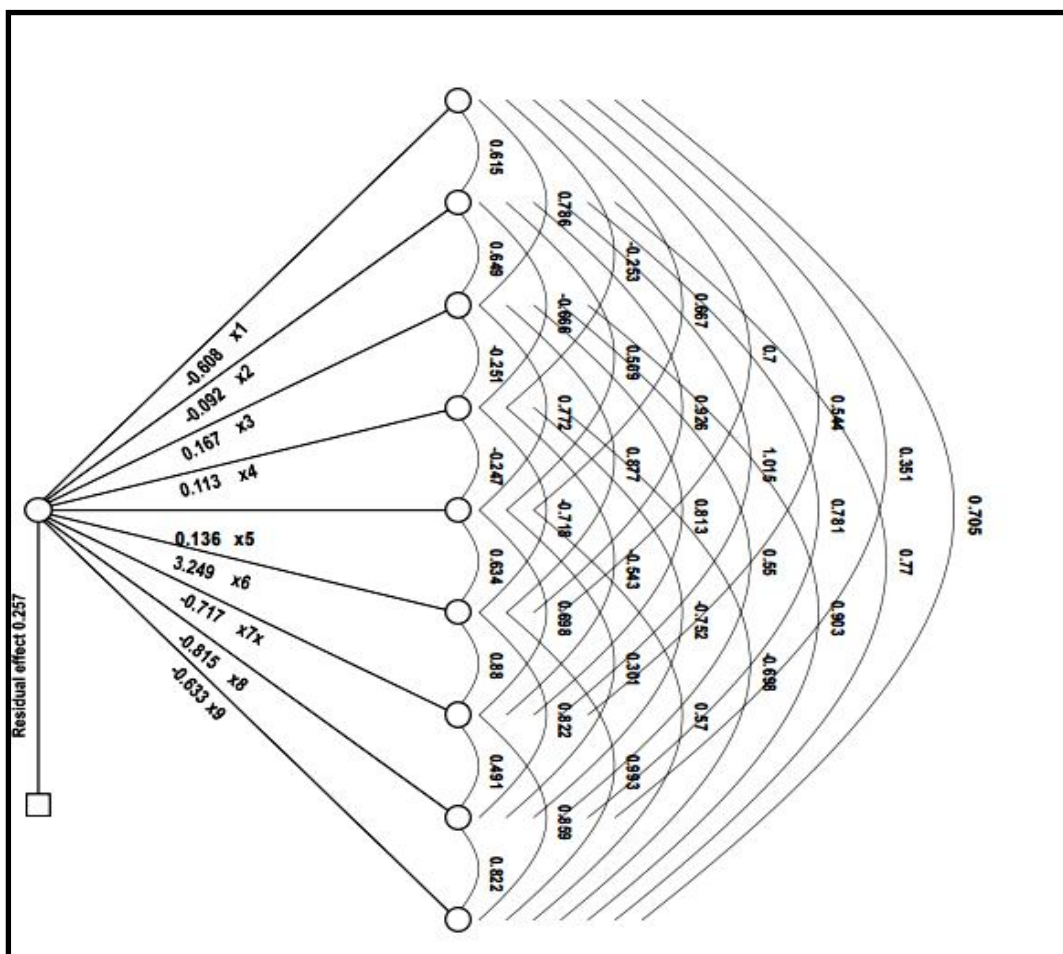


Fig. 5. Genotypic Path coefficient analysis of growth and yield parameters

significant correlation with tuber girth it showed negative non-significant correlation with internodal length. Similar observations were recorded by Sattar *et al.* (2007), Padma *et al.* (2009), Felenji *et al.* (2011), Jha (2012), Fekadu *et al.* (2013), Okpara *et al.* (2013), Rao *et al.* (2015), Pratana *et al.* (2016), Rao *et al.* (2017),

At both genotypic and phenotypic level, number of branches at 90 DAP was positively and significantly ( $p=0.01$ ) correlated with total leaves per vine at 90 DAP, leaf area at 90 DAP, number of tubers per vine, tuber girth, mean weight of tuber and tuber yield per vine. At phenotypic level, highly significant and negative correlation was expressed by internodal length at 90 DAP. These results are supported with the findings of Choudhary *et al.* (2000), Engida *et al.* (2006), Shashikanth *et al.* (2008), Jha (2012), Fekadu *et al.* (2013), Okpara *et al.* (2013), Pratana *et al.* (2016), Rao *et al.* (2017).

At both genotypic and phenotypic level, total leaves per vine at 90 DAP was positively and highly significantly ( $p=0.01$ ) correlation with leaf area, number of tubers per vine, length of tuber, tuber girth, mean weight of tuber, tuber yield per vine. Whereas it showed negative and non significant correlation with internodal length at both the levels. These results are in accordance with the results of Perez *et al.* (2001), Teshome *et al.* (2004), Padma *et al.* (2009), Khayatnezad *et al.* (2011), Jha (2012), Rangare and Rangare (2013), Kundy *et al.* (2014), Rao *et al.* (2015) and Rao *et al.* (2017).

Internodal length at 90 DAP showed highly significant and negative correlation ( $p=0.01$ ) with number of tubers per vine, tuber girth, mean weight of tuber and tuber yield per vine. While length of tuber had showed highly significant and positive correlation with internodal length at 90 DAP. Whereas it had negative non significant correlation with leaf area at 90 DAP at both genotypic and phenotypic level. These results are supported with the findings of Teshome *et al.* (2004), Choudhary and Mishra (2011), Padma *et al.* (2009), Afuape *et al.* (2011), Jha (2012), Rao *et al.* (2015), Pratana *et al.* (2016) and Mishra *et al.* (2017).

Leaf area at 90 DAP was highly significant and positive correlation ( $p=0.01$ ) with number of tubers per vine, length of tuber, tuber girth, mean weight of tuber and tuber yield per vine both at genotypic and phenotypic level. The reason for leaf area

significantly associated with tuber yield could be attributed to more amount of photosynthesis occurring. As a result, more photosynthesis would account for effective conversion of carbohydrates into economic yield by increasing the total tubers per vine or increasing average weight of tubers. At phenotypic level tuber girth showed positive significant association with leaf area at 90 DAP. These results are supported with the findings of Mondal (2003) and Nasiruddin *et al.* (2014).

At both the levels, total tubers per vine showed positive and significant correlation ( $p=0.01$ ) with length of tuber, tuber girth, mean weight of tuber and tuber yield per vine. These results are in contrast with those Teshome *et al.* (2004), Pratana *et al.* (2016), Mekonnen *et al.* (2015), Mishra *et al.*, (2017), Panigrahi *et al.* (2017), Okocha *et al.* (2018) and Magaji and Sodangi, (2020).

At genotypic and phenotypic level, tuber girth, mean weight of tuber and tuber yield per vine showed positive and highly significant correlation ( $p=0.01$ ) with length of tuber. Similar results were found by Perez *et al.* (2001), Teshome *et al.* (2004), Tirkey *et al.* (2011), Pratana *et al.* (2016), Tripathi *et al.* (2016) and Okocha *et al.* (2018).

The tuber girth had showed positive and highly significant correlation ( $p=0.01$ ) with mean weight of tuber and tuber yield per vine at genotypic and phenotypic level. These findings are in close agreement with the results obtained by Perez *et al.* (2001), Sattar *et al.* (2007), Shashikanth *et al.* (2008), Padma *et al.* (2009), Tirkey *et al.* (2011), Jha (2012), Rangare and Rangare (2013), Abdelmonem and Gendy (2014) and Nasiruddin *et al.* (2014), Rao *et al.* (2015), Pratana *et al.* (2016), Mekonnen *et al.* (2020), Vandana *et al.* (2020).

Average tuber weight was showed positive and highly significant correlation ( $p=0.01$ ) with tuber yield per vine at both genotypic and phenotypic level. Similar results were found by Khayatnezhad *et al.* (2011), Jha (2012), Rangare and Rangare (2013), Abdelmonem and Gendy, (2014), Okocha *et al.* (2018), Sodangi and Magaji (2020) and Mekonnen *et al.* (2020).

The correlation results obtained in the present study indicated that parameters *viz.*, vine length, number of leaves per vine, number of branches per vine, number of

tubers per vine, tuber weight, tuber length and tuber girth are the important components of yield as they showed positive significant association with yield. Therefore, to increase yield in sweet potato, the above-mentioned attributes can be used for selection.

### 5.3 Path coefficient analysis

Though correlation analysis specifies the association pattern of component traits with yield, they simply signify the overall influence of a particular character on yield rather than providing cause and effect relationship. Wright in 1921 developed the path coefficient analysis technique and Dewey and Lu in 1959 demonstrated the path coefficient analysis technique. Path coefficient analysis facilitates the partitioning of correlation coefficients into direct and indirect contribution of various characters on yield. It is standardized partial regression coefficient analysis. As such, it measures the direct influence of one variable upon another variable. Such data would be of great value in aiding the breeder to precisely identify the important component traits of yield and use the genetic stock for improvement in a planned way.

Correlations in combination with path study would give a better insight into cause-and-effect relationship between different pairs of characters. In the present investigation, path coefficient analysis between the components of orange fleshed sweet potato genotypes was worked out. Path analysis was discussed at genotypic level and phenotypic level.

In the present study, path coefficient analysis between the components of orange fleshed sweet potato genotypes was worked out of nine characters for tuber yield per vine (Table 15). Present investigation revealed that out of nine characters studied, the direct effects through total leaves per vine at 90 DAP, internodal length at 90 DAP, leaf area at 90 DAP, number of tubers per vine positively contributed towards tuber yield per vine at genotypic level. This indicated the true positive association with tuber yield per vine.

Therefore, direct selection for these traits would reward for improvement of yield. The results are in agreement with the findings of Sahu *et al.* (2005), Tirkey *et al.* (2011), Verma and Singh (2015), Pratana *et al.* (2016), Hajam *et al.* (2019) and Mekonnen *et al.* (2020).

Number of leaves per vine at 90 DAP had showed positive direct effect on tuber yield per vine. Whereas positive direct effect was due to its positive indirect effects through leaf area at 90 DAP and total tubers per vine at genotypic level. The results are in conformity with the findings of Parida *et al.* (1999), Sahu *et al.* (2005), Chandrakar (2007) and Ara *et al.* (2009).

Inter nodal length at 90 DAP had showed positive direct effect with tuber yield per vine it is due to its positive indirect effects through vine length at 90 DAP, number of branches per vine at 90 DAP, length of tuber, tuber girth, mean weight of tuber at genotypic level. The results are in conformity with the findings of Sahu *et al.* (2005) and Tirkey *et al.* (2011).

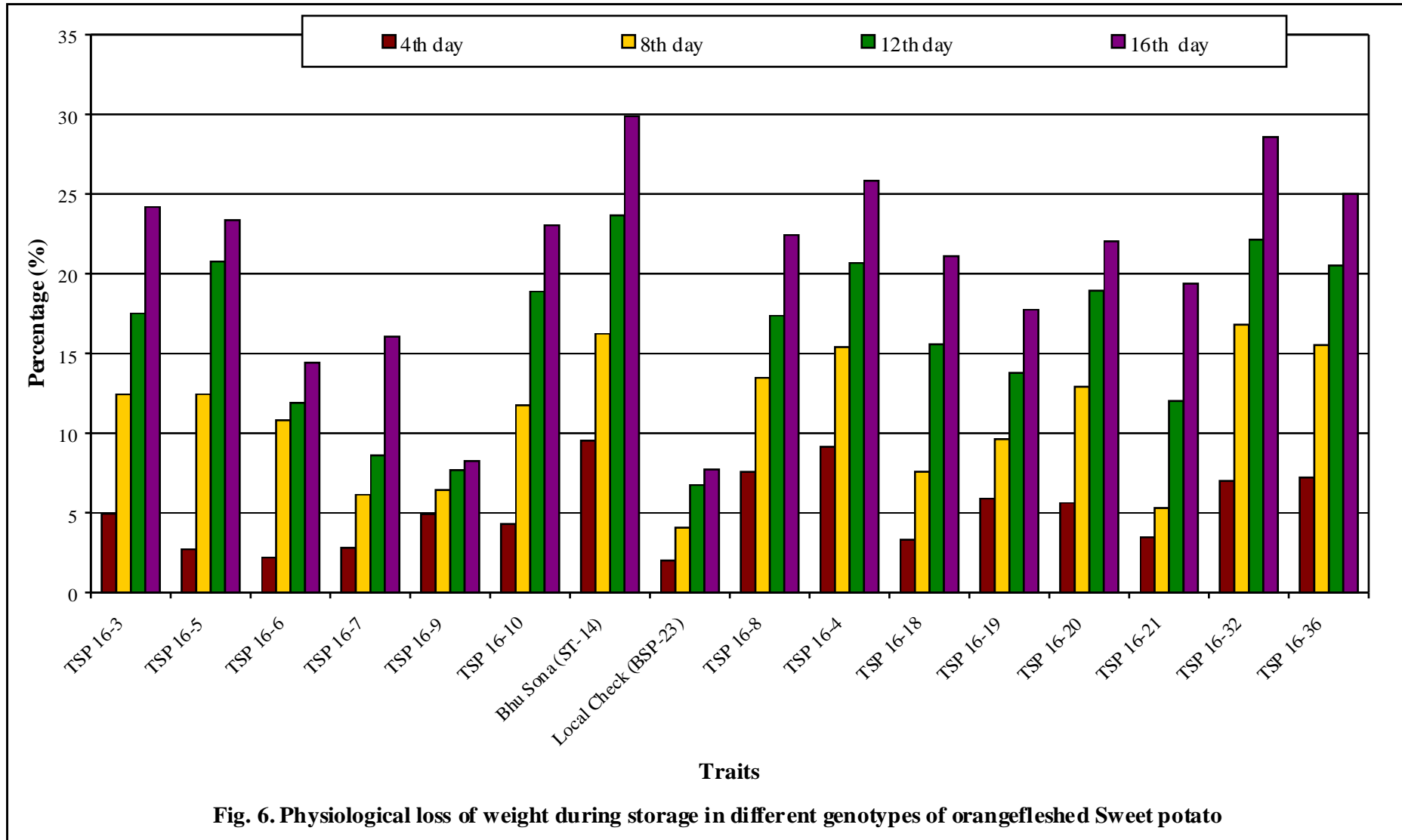
Leaf area at 90 DAP showed positive direct effect on tuber yield per vine was due to positive indirect effect through total leaves per vine at 90 DAP and total tubers per vine at genotypic level. The results are in conformity with the findings of Dereje and Basavaraja (2005), Roy and Singh (2006), Sattar *et al.* (2007), Singh (2008), Ummyiah *et al.* (2013), Singh *et al.* (2015), Singh and Deo (2018), Hajam *et al.* (2019) and Rizvi *et al.* (2020).

Number of tubers per vine had showed positive direct effect on tuber yield per vine due to its positive indirect effects *via*, total leaves per vine at 90 DAP and leaf area at 90 DAP. The similar results were obtained by Sahu *et al.* (2005), Engida *et al.* (2006), Sattar *et al.* (2006), Choudhary and Mishra (2011), Ummyiah *et al.* (2013), Singh *et al.* (2015) Pratana *et al.* (2016), Hajim *et al.* (2019), Gehan *et al.* (2019) and Sodangi and Magaji (2020).

## **5.4 Quality parameter and weevil infestation**

### **5.4.1 Physiological Loss of Weight (PLW)**

In present study the results pertaining to physiological loss of weight (PLW) differed significantly among the genotypes presented in Fig 6. The least physiological loss in weight was noticed in the genotype BSP-23 while the highest PLW was recorded in ST-14. The higher and lower PLW of tubers was due to increased or decreased transpiration changes with progress of storage period along with the genetic makeup of



the plant as well as prevailing environmental conditions. These results are in conformity with the findings of Dandago and Gungula (2011), Mehta and Ezekiel (2010) in potato, Sharavati *et al.* 2018, Prathiksha and Naik (2019) in sweet potato genotypes, Patel *et al.* (2018) in cassava and Thriveni *et al.* (2019) in orange fleshed sweet potato genotypes.

#### **5.4.2 Visible appearance (scores)**

The significant difference was observed from day one to thirty days after storage for visible appearance (shape) of tubers presented in Table 9. The genotypes TSP 16-9, TSP 16-10, TSP 16-18, BSP-23, TSP 16-20, TSP 16-32 and TSP 16-36 recorded good score for visibility on 15 days after storage. However, the visibility values were not up to the mark after 30 days after storage, because of more than 10 per cent weight loss of tuber during storage results in shriveled appearance of tubers which in terms reduces the marketability of sweet potatoes. Whereas genotype TSP 16-4 maintained the good score up to 30 days after storage for tuber shape followed by TSP 16-8 and TSP 16-18. The similar experimental result found by Nipa *et al.* (2013), Prathiksha and Naik (2019) in sweet potato genotypes.

#### **5.4.3 Skin and flesh color (scores)**

In the present study, the genotype ST-14, TSP 16-7 maintained its dark orange color throughout the storage due to presence of high amount of beta-carotene and the genotype TSP16-20 had the lowest amount of beta-carotene hence having light orange flesh. The skin of different genotypes exhibited different colors like pale yellow, pale brown, brown, light pink and light red. These results were similar with the result of Ali *et al.* (2015). There was no difference in flesh color throughout the storage, but the skin color of all the genotypes turned to brown and brownish due to loss of moisture at the end. Similar results were obtained by Ji *et al.* (2015) in potato and Prathiksha and Naik (2019) in sweet potato genotypes.

#### **5.4.4 Weevil incidence (%)**

The significant differences were observed for weevil infestation among sixteen orange fleshed sweet potato genotypes (Fig. 7). The genotype TSP 16-19 showed the lowest incidence of weevil infestation, whereas the weevil incidence was highest in the

genotype TSP 16-9. These results are in conformity with the findings of Allolli *et al.* (2012), Desai *et al.* (2013) and Thriveni *et al.* (2019) in sweet potato genotypes.

#### **5.4.5 Starch content**

The starch content in tuber was recorded highest in TSP 16-7 followed by TSP 16-10 and TSP 16-9 genotypes. Amount of starch in different varieties is a character which varies with genotype and different chemical constituents in the tubers as quoted by Zhang *et al.* (2002). While BSP-23 genotype had lowest starch content in tuber. The reduction in starch was due to the catabolic reactions in storage leading to conversion of complex starch molecules into simpler sugars. Similar information have also been reported by Khayatnezhad *et al.* (2011), Prathiksha (2017), Sharavathi *et al.* (2018) in sweet potato genotypes, Patel *et al.* (2018) in cassava and Thriveni *et al.* (2019) in orange fleshed sweet potato genotypes.

#### **5.4.6 Beta carotene (mg/100g)**

In the current study genotype ST-14 recorded significantly superior beta carotene content followed by TSP 16-7 and TSP 16-5. This variation was found due to the difference in the flesh color which was depending on genotypic factor. Blessington *et al.* (2010), Desai *et al.* (2013). Similar results were noticed by Prathiksha and Naik (2019), Sharavathi *et al.* (2018) in sweet potato and Thriveni *et al.* (2019) in orange fleshed sweet potato genotypes.

#### **5.4.7 Dry matter (%)**

In present study the maximum dry matter was recorded by genotype TSP 16-7. However, TSP 16-3 was found to be next to TSP 16-7 by maintaining second highest dry matter content of tuber. These results are found to be similar with result obtained by Prathiksha and Naik (2019), Thriveni *et al.* (2019) in orange fleshed sweet potato genotypes.

## 6. SUMMARY AND CONCLUSIONS

The present investigation entitled “Evaluation of orange fleshed sweet potato (*Ipomoea batatas* L.) genotypes” was carried out at Regional Horticultural Research and Extension Centre, Kumbapur, Dharwad, during 2020-2021 with the principle objective to study the variability, character association and path analysis for growth, yield and quality parameters. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications and the experimental material consisting of 16 potential genotypes of orange fleshed sweet potato procured from AICRP on tuber crops, Dharwad. Findings of the research work are summarised below.

Observations were recorded for vine length, number of branches, number of leaves per vine, internodal length, leaf area, number of tubers per vine, tuber length, tuber girth, tuber weight, tuber yield per vine, tuber yield per plot, tuber yield per hectare, starch content, beta-carotene, dry matter physiological loss of weight, scoring of tubers, scoring of flesh and color of tubers and percent infestation of sweet potato weevil. Finally, data was subjected to statistical analysis by applying statistical procedure for study of genetic variability, genotypic variance, phenotypic variance, coefficient of variance, heritability, genetic advance, correlation and path coefficient analysis for above characters.

### 6.1 Mean performance of genotypes

Mean performance of various characters observed that genotype TSP 16-6 recorded at highest vine length, number of branches per vine, number of leaves per vine, leaf area, number of tubers per vine, tuber length, weight of tuber, tuber yield per vine, tuber yield per plot and tuber yield per hectare. Highest tuber girth was found in BSP-23 and genotype TSP 16-21 recorded at highest internodal length.

Genotype TSP 16-7 recorded maximum amount of dry matter and starch. Highest beta carotene content was recorded by genotype ST-14.

### 6.2 Variability studies

Analysis of variance had shown significant ( $p=0.05$ ) difference among genotypes for all sixteen traits related to growth, yield and quality parameters.

The phenotypic coefficient of variation was more than (>20%) genotypic coefficient of variation for all the characters studied. The high genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were observed for total leaves per vine at 60 DAP and 120 DAP, leaf area for all growth parameters such as 60, 90 and 120 DAP, mean weight of tuber, tuber yield per vine, tuber yield per plot, tuber yield per hectare and beta carotene by indicating the maximum amount of variability present in the genotypes and would be amenable for further selection.

Estimates of genotypic coefficient of variation and phenotypic coefficient of variation were moderate (10-20%) for traits like vine length at 60 DAP and 90 DAP number of leaves per vine at 90 DAP, internodal length at 60, 90 and 120 DAP, number of tubers per vine, tuber girth, starch percent and dry matter this indicates the limited amount of variation for these traits.

Low phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were recorded for characters like vine length at 120 DAP and number of branches per vine at 90 DAP.

Low GCV and high PCV were observed for number of branches per vine at 120 DAP and length of tuber.

High heritability (>60%) coupled with high genetic advance (>20%) as per cent of mean was observed for vine length at 60 and 90 DAP, internodal length, number of leaves per vine, leaf area at 60, 90 and 120 DAP, number of tubers per vine, tuber girth, mean weight of tuber, tuber yield per vine, tuber yield per pot, tuber yield per hectare it indicates that these characters are controlled by additive gene effect and are less influenced by environmental factors, therefore, these characters can be improved by simple selection.

High heritability coupled with moderate genetic advance as per cent of mean was noticed for number of branches per vine at 90 and 120 DAP, tuber length and vine length at 120 DAP. This indicates the prevalence of non-additive components and there can be little response to selection and these characters can be exploited for some extent through further selection.

### 6.3 Correlation and path analysis

Correlation studies revealed that tuber yield per vine exhibited highly significant ( $P=0.01$ ) and positive association with vine length at 90 DAP, number of branches per vine at 90 DAP, total leaves per vine at 90 DAP, leaf area at 90 DAP, number of tubers per vine, tuber length, tuber girth, tuber weight both at phenotypic and genotypic level whereas, it had highly significant negative association with internodal length at 90 DAP. Since, these association characters are in the desirable direction, it indicates that simultaneous selection for these characters would be rewarding for improving the tuber yield per vine.

The path coefficient analysis studies reported among nine traits for tuber yield per vine had highest positive and direct effect with vine length at 90 DAP, number of branches per vine at 90 DAP, leaf area at 90 DAP, total leaves per vine at 90 DAP, number of tubers per vine, length of tuber, tuber girth and weight of tuber. Highest negative effect was exhibited by internodal length at 90 DAP both at phenotypic and genotypic level. The direct selection of these traits would be rewarding for improvement in the tuber yield per vine.

From the current study it can be concluded that three superior genotypes *viz.*, TSP 16-6, TSP 16-9 and BSP-23 were identified as best superior orange fleshed sweet potato genotypes with respect to growth and yield attributes. For quality parameters, TSP 16-7, ST-14 genotypes reported good source of starch and beta carotene respectively. Therefore, this genotypes can be consider for further varietal improvement.

#### Future line of work

- Wide range of variability was present for all the characters studied. Hence, attention needs to be given for these traits during selection for improvement of tuber yield.
- To identify the genotypes which have processing qualities, medicinal properties and exploit in processing industries.

- The genotypes included under the investigations may be evaluated at different agro-climatic zones of Karnataka to identify the most suitable genotype showing stability in performance for desirable characters.
- The genotype TSP 16-6, TSP 16-9 and BSP-23 were identified maximum tuber yielding genotypes than rest. It is essential to evaluate these high yielding genotypes under different locations to check their stability and to use them for commercial cultivation.
- On the basis of tuber quality evaluation TSP 16-7, ST-14 reported good source of starch and beta carotene. Hence these genotypes can be considered for further varietal improvement program and popularize among the farmers for their higher nutritional qualities.

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**Appendix I: Meteorological data recorded during experimental period at RHREC, Kumbapur (Dharwad), UHS, Bagalkote during 2020-21.**

Month (2020-21)	Temperature ( <sup>0</sup> C)		Relative humidity (%)		Rainfall (mm)	
	Maximum	Minimum	Maximum	Minimum	mm	Days
September	28.4	20.4	89.1	79.2	186	11
October	29.1	20.0	87.9	76.0	202	10
November	29.4	17.0	75.2	50.1	0.6	0
December	28.9	14.6	75.4	46.0	0.0	0
January	29.4	15.9	77.1	49.7	27.2	3
February	30.3	15.2	67.9	37.7	10.0	1
Mean	29.25	17.18	78.77	56.45	70.97	4.17

Source: Automatic weather station, RHREC, Kumbapur (Dharwad), UHS, Bagalkote.

**EVALUATION OF ORANGE FLESHED SWEET POTATO (*Ipomoea batatas* L.)  
GENOTYPES**

**PALLAVI WANI**

**2021**

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**ABSTRACT**

An investigation on evaluation of orange fleshed sweet potato genotypes was carried out during *rabi* season 2020-2021 at Regional Horticultural Research and Extension Center, Dharwad (Kumbapur Farm). The experiment was laid out by adopting Randomized Complete Block Design. Analysis of variance revealed highly significant differences among the genotypes were observed for all the characters under study. High heritability (> 60 %) coupled with high genetic advance as per cent over mean (>20 %) were recorded for the characters such as, vine length, number of leaves per vine, leaf area, internodal length, number of tubers per vine, tuber girth, mean weight of tuber, tuber yield per vine, tuber yield per plot, tuber yield per hectare, starch content, dry matter percent and beta carotene content indicating the prevalence of additive gene action for these traits. Thus, there is ample scope for improving these characters through direct selection.

Correlation studies showed that tuber yield per vine exhibited positive and highly significant phenotypic and genotypic association with vine length at 90 DAP, number of branches per vine at 90 DAP, number of leaves per vine at 90 DAP, leaf area at 90 DAP, number of tubers per vine, tuber length, tuber girth and mean weight of tuber. Path analysis revealed that highest positive direct effect on tuber yield per vine was shown by number of tubers per vine followed by leaf area at 90 DAP, internodal length at 90 DAP, number of leaves per vine at 90 DAP.

The present study identified three promising genotypes viz., TSP 16-6, TSP 16-9 and BSP-23 with respect to growth and yield attributes which can be utilized in the further crop improvement programme. For quality parameters, TSP 16-7 and ST-14 genotypes reported good source of starch and beta carotene respectively hence this genotypes can be consider for further varietal improvement.

