

**Performance of Orange Fleshed Sweet Potato
(*Ipomea batatas* L.) genotypes for yield and
yield attributing characters**

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By

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AUGUST, 2023



**AFFECTIONATELY
DEDICATED TO
*MY BELOVED PARENTS***

***Dr.D.V.Swami
D.V.Lakshmi,
D.V.Vineeth
(brother)***

&

***My Chairman
Dr.Sheriful Alam***

ASSAM AGRICULTURAL UNIVERSITY
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CERTIFICATE – I

This is to certify that the thesis entitled “**Performance of orange fleshed sweet potato (*Ipomea batatas* L.) genotypes for yield and yield attributing characters**” submitted to the Faculty of Agriculture, Assam Agricultural University in partial fulfilment for the degree of **Master of Science (Agriculture)** in **Horticulture** is a record of research work carried out by **Dokka Vara Vinod** under my personal supervision and guidance.

All kinds of help received by him have been duly acknowledged.

No part of this thesis has been reproduced elsewhere for any degree.

Place: Jorhat

Date:.....August, 2023

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CERTIFICATE – II

This is to certify that the thesis entitled “**Performance of orange fleshed sweet potato (*Ipomea batatas* L.) genotypes for yield and yield attributing characters**” submitted by **Dokka Vara Vinod**, bearing **Roll No. 2021-AMJ-205** to the Assam Agricultural University, in partial fulfilment of the requirement for the degree of **Master of Science (Agriculture)** in the discipline of **Horticulture** has been examined and approved by the Student’s Advisory Committee after viva-voce.

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Place: Jorhat

The, 2023

The author

ABSTRACT

The present investigation was carried out with the principle objective to study the variability, heritability, character association and path analysis for morphological and quality parameters in orange-fleshed sweet potato genotypes at an Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the year 2022-2023. Analysis of variance revealed significant differences for all the morphological and quality characters viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%), length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, marketable tuber yield per plant (g), marketable tuber yield per hectare (t/ha), total soluble solids (°Brix), total carotenoids (mg/100g), starch content (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days). High PCV, GCV and high heritability in conjunction with high genetic advance as per cent of mean were observed for morphological parameters viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), fresh weight of tuber (g), dry weight of tuber (g), diameter of tuber (cm), number of tubers per plant, marketable tuber yield per plant (g), marketable tuber yield per hectare (t/ha) and quality parameters like total carotenoids (mg/100g), starch content (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days) indicates the preponderance of additive gene action governing the inheritance of these characters and offers the best possibility of improvement through simple selection procedures.

Correlation study revealed that yield can be improved by selecting genotypes having more vine weight per plant, fresh weight of plant, dry weight of plant, fresh weight of tuber, dry weight of tuber and diameter of tuber. The highest positive direct effects on marketable tuber yield per plant was shown by fresh weight of whole plant, plant dry matter content, dry weight of tuber and diameter of tuber. The highest negative direct effects were exhibited by vine weight per plant, dry weight of whole plant, tuber dry matter content and number of tubers per plant. Characters having high positive direct effects along with positive significant correlation with marketable tuber yield per plant can be directly selected and simultaneously the characters which show high positive indirect effects can also be selected for the improvement of yield.

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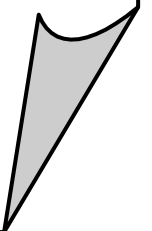
LIST OF ABBREVIATIONS AND SYMBOLS

%	: per cent
@	: at the rate of
&	: and
⁰ C	: degree Celsius
>	: Greater than
<	: Lesser than
AICRP	: All India Coordinated Research Project
ANOVA	: Analysis of variance
A.P.	: Andhra Pradesh
CD	: Critical difference
cm	: centimeter
cm ²	: centimeter square
CTCRI	: Central Tuber Crops Research Institute
df	: degrees of freedom
DAP	: Days after planting
dSm ⁻¹	: deci siemen per meter
EC	: Electrical conductivity
EMSS	: Error Mean Sum of Squares
ESS	: Error Sum of Squares
EVP	: Evaporation
<i>etc.</i> ,	: and so on
<i>et al.</i>	: and others
Fig.	: Figure
f.w.	: fresh weight
FYM	: Farm yard manure
g	: gram
G	: Genotype

GA	: Genetic Advance
GAM	: Genetic Advance as per cent of mean
GCV	: Genotypic Coefficient of Variation
g ⁻¹	: per gram
HRS	: Horticultural Research Station
ha	: hectare
h ²	: heritability in broad sense
<i>i.e.</i> ,	: that is
kg	: kilogram
kmph	Kilometer per hour
kg ha ⁻¹	: kilogram per hectare
m	: meter
mg	: milligram
mm	: millimeter
ml	: milliliter
KJ	: Kilo Joules
MT	: Metric tonnes
MSL	: mean sea level
MSS	: mean sum of squares
NHB	: National Horticultural Board
no.	: Number
OFSP	: Orange flesh sweet potato
P	: Phenotype
PCV	: Phenotypic Coefficient of Variation
pH	: puissance de hydrogen
ppm	: parts per million
RF	: Rainfall
RH	: Relative humidity

RGR	: Relative growth rate
RBD	: Randomized block design
RMSS	: Replication Mean Sum of Squares
RSS	: Replication Sum of Squares
SE(d)	: Standard error difference
S.Em	: Standard error mean
SS	: Sum of Squares
t/ha	: tonne per hectare
TrMSS	: Treatment Mean Sum of Squares
T _r SS	: Treatment Sum of Squares
viz.,	: namely
WS	: Wind speed

Introduction... 



CHAPTER-I

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is a starchy tuber crop commonly consumed worldwide. It is a herbaceous, perennial vine but grown as annual crop belongs to the Convolvulaceae family. It was originated in Central America but grown throughout the tropical, sub-tropical, and warmer temperate regions of the world. In Assam, it is commonly known as Meeta aloo and popularly known as sakarkand in India. The genus *Ipomea* consists of about 175 species amongst which *Ipomoea batatas* is the only tuber-bearing species even though, a few species are known to have thickened roots. All the species in section *Batatas* have basic chromosome number $X = 15$. It is a hexaploidy having $2n=6X= 90$ chromosomes (Jones, 1965) and considered as one of the most important food security crops due to its low agriculture input requirements and high yields in wider climatic conditions.

Sweet potato is positioned as the seventh most major food crop in the world, fourth in tropical countries and fifth most essential food crop on a fresh weight basis in developing countries after rice, wheat, maize, and potato (Karyeija *et al.*, 1998). According to FAO, sweet potatoes are grown in 111 countries, of which 101 are classified as ‘developing nations’. Among the world’s tuber crops, sweet potato ranks second only to potato in economic importance. Though it is cultivated in all the states of India, the major area under this crop is confined to the states of Orissa, Bihar, Uttar Pradesh and Madhya Pradesh. In India, it covers an area of 0.106 million ha producing 1.12 million tonnes of tubers with a productivity of 10.30 tonnes per ha. Presently in Assam, sweet potato production is around 27,670 tonnes with an area of about 5,050 hectares and a productivity of 14.80 tonnes per ha (Anon., 2022).

Sweet potatoes are drought-tolerant to some extent. It grows extremely well in areas with an average annual rainfall of 750 mm and the optimum temperature range for tuber production is 20 to 30°C. Short days with low light intensity encourage tuber development, while lengthy days with high light intensity encourage vine growth.

Sweet potato could be a better competitor as food, feed and industrial raw material (Tsou *et al.*, 1997). The carbohydrate content of the sweet potato tubers varies from 25 to 30 per cent, while the rest is composed of moisture content (58 to 72 %). Sweet potatoes being good sources of vitamin C, vitamin E, dietary fiber, calcium, potassium, iron and are low in fat and cholesterol. However, they also contain moderate quantities of thiamine (B_1),

riboflavin (B₂), niacin, pantothenic acid (B₅), pyridoxine (B₆) and folic acid. Moderate quantities of sodium, magnesium, manganese and zinc are also present. The tubers are used as subsidiary food after boiling, baking and frying, moreover tubers also form an industrial raw material for the production of starch, alcohol, pectin, *etc.* The comparative short duration coupled with its innate power for tremendous dry matter production has enabled sweet potato to rank as the foremost root crop in respect of calorie value. The orange-fleshed sweet potato, which is exceptionally rich in β -carotene, is gaining popularity as the cheapest source of antioxidants with several physiological properties such as anti-oxidation, anti-cancer and protection against liver injury and is best suited as a biofortified crop to combat malnutrition in small and marginal farming communities. Orange-Fleshed Sweet Potato (OFSP) is a specific type of sweet potato distinguished by its vibrant orange-coloured flesh. It is highly regarded for its nutritional value and is often referred to as a "superfood" due to its rich content of vitamins and minerals.

Knowledge of genetic diversity aids breeders in selecting desirable parents to use in breeding programmes in sweet potato crop development. The various genotypes can be crossed to develop superior high-yielding hybrids with resistance to various abiotic and biotic stress. In view of the increasing value and demand of this crop day by day, there is a need to evaluate such genotypes which are suitable to specific agroecological conditions and provide good quality produce with higher yield. It is therefore required to evaluate different genotypes of sweet potato for higher yield and quality attributes, which fulfill the requirements of farmers and consumers.

For developing a desirable variety in any crop improvement programme in particular region, depends upon the variability present in that particular region and knowledge of the various components associated with yield and yield-attributing characteristics of the crop. Yield is a complex character influenced by various component factors. The estimation of different genetic parameters, character associations and their interrelationship is the pre requisite and necessary step for the selection of high yielding genotype with desirable traits. From the study of correlation and path analysis, this information can be obtained easily.

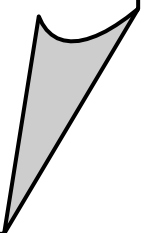
The correlation coefficient is a statistical measure of the strength of the relationship between the relative movements of two variables. It provides an idea about the relations present between the yield, quality and its contributing characters. Association studies among the yield contributing parameters is important for understanding the direction of selection and increase yield at shortest time period. It only reveals the magnitude and direction of association between any two variables but the path coefficient analysis measures the direct

effect of one character upon other character and it helps in partitioning the correlation coefficient into components of direct and indirect effects. Therefore, trait association studies coupled with path analysis are a powerful tool to study the character association and their final impact on tuber yield, which helps the selection procedure of the high yielding genotypes with good quality characters.

In any breeding program of complex characters such as yield for which direct selection is not effective, it becomes essential to measure the contribution of each of the component variables to the observed correlation and to partition the correlation into direct and indirect effects. Keeping these in view, the present investigation was carried out to know the genetic variability, correlation and path analysis in available orange-fleshed sweet potato genotypes under Jorhat, Assam conditions for yield and yield attributing characters. Hence an experiment entitled “Performance of orange-fleshed sweet potato (*Ipomea batatas* L.) genotypes for yield and yield attributing characters” was undertaken with the following objectives:

1. To characterize orange-fleshed sweet potato genotypes for morpho-biochemical traits.
2. To assess genetic variation in orange-fleshed sweet potato genotypes.

Review of Literature...✍



CHAPTER II

REVIEW OF LITERATURE

Sweet potato (*Ipomoea batatas* L.) is the second most important tuber crop and the seventh most important food crop of the world. It is an important starchy food crop of tropical and sub-tropical countries. The phenotype of a morphological trait is the joint product of genotype and environment. Hence, the estimates of variability and its heritable components for the yield contributing characters in the available germplasm are prerequisites for a breeding programme for high yield.

It is necessary to understand the genetic architecture of the various characters of importance and interrelationship among them. In the present investigation, an attempt has been made to study genetic variability, heritability, genetic advance, correlation and path co-efficient analysis in orange fleshed sweet potato genotypes. A brief review of available literature pertaining to the present investigation in sweet potato has been presented in this chapter under the following headings.

- 2.1 Variability
- 2.2 PCV, GCV, heritability and genetic advance
- 2.3 Correlation studies
- 2.4 Path co-efficient analysis

2.1 VARIABILITY

Any crop improvement depends on the magnitude of genetic variability and the extent to which the desirable characters are heritable. Sweet potato is such a crop having wide range of variability in tuber skin, flesh colour, tuber shape, time of maturity, resistance to disease, leaf shape and several other morphological characters viz, tuber diameter, tuber length and number of tubers which can be exploited for the development of desirable genotypes. Knowledge of the total genotypic variance in a plant population is of great importance to the breeder to manipulate the variance for the improvement of the characters. Hence, an attempt has been made to collect back ground information on the amount of genetic variability present in the sweet potato genotypes in order to prepare a guideline for selection of parents as a donor which will be further utilized in the breeding programme for the development of desirable varieties for agro-climatic conditions of Jorhat, Assam. The role played by

environment in expression of economic characters also needs to be taken into account. Burton (1952) suggested that co-efficient of variability together with heritability estimate will give a good picture of amount of genetic advance to be expected from selection. Several workers observed wide range of genetic variability for vine and tuber characters in sweet potato (Kamalam, 1990; Vimala and Lakshmi, 1990; Rao *et al.*, 1992; Engida *et al.*, 2007; Cavalcante *et al.*, 2010; Vimala and Hariprakash 2011; Pushpalata *et al.*, 2011; Richardson V.R., 2012; Ashok *et al.*, 2013; Thiyagu *et al.*, 2013; Mohammed *et al.*, 2015; Shivanand *et al.*, 2015; Muluken, D. and Abiyot A., 2016; Meenakshi *et al.*, 2017; Fekadu *et al.* 2018; Sharavati *et al.*, 2018; Ochieng, 2019; Rahajeng *et al.*, 2020; Bililign *et al.*, 2021; Ashish *et al.*, 2022; Bassey *et al.*, 2022 and Harriman *et al.*, 2023).

2.1.1 MORPHOLOGICAL VARIABILITY

Kamalam (1990) conducted a trial with fifteen cultivars of sweet potato and observed very high variability for vine length, vine thickness, number of branches, number of tubers and tuber yield.

Wilckens *et al.* (1993) studied on 32 accessions of sweet potato and observed that accession number 5 and 27 showed variability for growth habit and internodal length respectively.

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

Engida *et al.* (2007) conducted a study on 30 sweet potato genotypes and revealed that there was significant variability among the genotypes for the characters viz., vine length, vine internodal length, leaf area, above ground fresh and dry weight per plant, storage root number per plant, storage root length and diameter, individual storage root weight, harvest index, storage root dry matter content and storage root fresh yield per plot.

Cavalcante *et al.* (2010) conducted an experiment on nine clones along with two varieties of sweet potato and revealed that, clones 6 and 11 recorded the highest marketable root yield and clones 8, 14 and the variety 'Rainha Prata' recorded the highest phyto mass yield on the shoot.

Vimala *et al.* (2011) 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 3.00 to 20.00 t/ha in upland and 3.00 to 30.00 t/ha in lowland condition and dry matter content varied from 18.50 to 29.20 % in both the conditions.

Vimala and Hariprakash (2011) evaluated 250 hybrid progenies on the basis of vine, storage root yield and dry matter content and identified superior F₁ clones for yield and other attributes. They reported that large gene pool is required to generate the promising variety of considerable value.

Pushpalata *et al.* (2011) evaluated 15 genotypes of sweet potato and recorded observations on vine length, vine weight per plant, neck length of tuber, tuber diameter and revealed that genotypes, IGSP.C-18, 440038, 440036 and IGSP.C-16 were superior than Sree Rethna in respect of tuber yield.

Richardson V.A. (2012) evaluated six genotypes of sweet potato for tuber yield and reported that the variety 'Six Weeks'(early maturity) produced high dry matter content and high marketable yield (25.50 t/ha) followed by 'Antigua' (25.20 t/ha).

Vimala *et al.* (2012) studied on 1600 orange fleshed sweet potato genotypes and concluded that vine weight and root weight varied according to the clone and environmental conditions.

Anuj, K.C. and Singh, A.K. (2013) evaluated the performance of seven orange fleshed sweet potato genotypes and observed wide range of variability. Vine length was ranged from 127.89 to 235.91 cm, number of tubers per plant ranged from 1.89 to 4.99, weight of the tuber per plant was ranged from 0.11 to 0.34 kg, dry matter content was ranged from 17.17 to 30.33 %, harvest index was ranged from 54.72 to 89.66 % and marketable tuber yield was ranged from 5.37 to 20.74 t/ha.

Twelve cassava genotypes were evaluated to assess genetic variability for root yield and its components at three locations on six traits viz., number of branches per plant, plant height, root number, root weight, shoot weight and root dry matter and disclosed that genotype x location interaction was significant for all the characters studied indicating considerable influence of the environment on the expression of the traits (Kundy *et al.*, 2015).

Danquah *et al.* (2016) evaluated the agronomic performance among a collection of local and exotic cassava genotypes and observed highly significant

genotype effects for all the growth and yield traits measured and reported that the genotypes from exotic collection recorded the highest average plant height, early branching, highest average number of leaves less incidence of cassava mosaic disease, highest average root yield, more roots per plant, high dry matter content, highest mean root weight and high harvest index compared to local cassava collections.

Ratna *et al.* (2019) studies the variability of 30 sweet potato genotypes and revealed that the average character of vines length has a range from 55.00 cm to 292.00 cm, segment lengths from 2.25 cm to 4.75 cm, vines diameter from 3.25 cm to 6.25 cm, weight of vines from 425 g to 1,625.00 g, the number of large storage root is greater than 0.5 storage root up to 4.5 storage root, the weight of large storage root from 40 g to 1,010.00 g, storage root length from 12.37 cm to 23.62 cm, storage root diameter from 2.37 cm to 8.00 cm.

Rahajeng *et al.* (2020) observed the performance and genetic parameters of thirty sweet potato accessions for eleven characters and reported significant differences among the genotypes for almost all characters except weight of the non-saleable root. The root dry matter content of thirty accessions ranged between 23.64% and 34.93% with an average 28.70%. Highest tuber yield, harvest index and weight of root were recorded for the variety 'MLGI 0037', while variety MLGI 0031 showed the lowest value.

Ashish *et al.* (2022) evaluated 20 genotypes of colour fleshed sweet potato for fourteen morphological characters and observed wide range of variability for the characters such as biological yield per plant, vine length, leaf area index, average tuber weight, harvest index and tuber yield per plant.

Bililign *et al.* (2021) conducted a study to determine variability for yield and yield related traits in 24 orange fleshed sweet potato genotypes and observed significant differences among genotypes for vine length, vine inter-node length, vine diameter, petiole length, mature leaf size, root length, root girth, above ground fresh weight, harvest index, root dry matter content, root beta carotene content, skin colour, flesh colour, number of roots per plant, marketable root yield, unmarketable root yield and total storage root yield.

Ochieng, L.A (2019) conducted a study to evaluate agro-morphological characteristics of 68 sweet potato genotypes and observed significant differences for petiole length, vine internode diameter, storage root cortex thickness, storage root

stalk, storage root length, storage root diameter, weight of the largest storage root and storage root yield of sweet potato genotypes.

Pallavi Wani *et al.* (2022) undertook the investigation to estimate the genetic variability among sixteen orange-fleshed sweet potato genotypes and revealed highly significant differences among the genotypes and observed for 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 per cent and beta carotene content.

2.1.2 QUALITY VARIABILITY

Akkamahadevi *et al.* (1996) recorded the highest starch content of 84.70 per cent on dry weight basis in the sweet potato clone, Belgam local.

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

Sahu *et al.* (2005) reported the highest total soluble solids in sweet potato genotypes IB-90-15-9 for Chhattisgarh plains.

Vimala *et al.* (2009) evaluated 40 clones of orange fleshed sweet potato during different seasons viz., *summer*, *khariif* and *rabi* and observed that total carotenoids content ranged from 8.50-15.00 mg/100g fresh weight and β - carotene varied from 6.80-13.70 mg/100g fresh weight basis.

Pushpalata *et al.* (2011) evaluated 15 genotypes of sweet potato and recorded observations on starch content, total sugar content, carbohydrate content and TSS of sweet potato and revealed that genotypes like IGSP. C-18, 440038, 440036 and IGSP.C-16 were superior than Sree Rethna in respect of quality parameters.

Vimala *et al.* (2011) evaluated 42 orange fleshed sweet potato hybrids in upland and low land conditions for storage root yield along with a control variety of Sree Kanaka. Out of 42 hybrids studied, 22 hybrids possessed high β -carotene content (10.00-15.00 mg/100g fresh weight).

2.2 PCV, GCV, HERITABILITY AND GENETIC ADVANCE

Phenotype of an individual is determined by genotype and environment in which it grows. Success of a breeder in changing and improving the heredity of a character depends upon the degree of correspondence between phenotypic and genotypic values. Heritability is a measure that provides this information (Dabholkar,

1992). Heritability in broad sense or degree of genetic determination is proportion of total hereditary variance to phenotypic variance. The more useful estimate *i.e.* narrow sense heritability or degree of resemblance between relatives is ratio of additive genetic variance to phenotypic variance (Falconer, 1989). The most important function of heritability in the genetic studies of metric characteristics is its predictive role in expressing the reliability of phenotypic value as a guide to breeding value (Falconer, 1989). Genetic advance means improvement in the performance of selected lines over original population.

Heritable variation can be determined with greater accuracy, when heritability is studied along with genetic advance (Swarup and Chaughale, 1962). High heritability with high genetic gain is associated with additive gene effects (Panse, 1957). On the contrary, non additive gene effect (dominance or epistasis) is associated with characters exhibiting high heritability and low genetic advance.

Vimala and Lakshmi (1990) reported estimates of heritability high for tuber characters like tuber length, tuber weight and tuber girth and low for vine length in sweet potato.

Chen *et al.* (1995) conducted their studies on 30 sweet potato genotypes and observed that the genetic variation ranged from 20.03 to 37.65%.

Studies conducted on 25 genotypes of sweet potato by Rajesh Kumar Jain and Ganguli (1996) and revealed that vine length, number of branches, number of leaves and tuber yield showed high genotypic and phenotypic coefficients of variation, where as genotypic coefficient of variability ranged from 11.12 % (tuber length) to 39.07 % (number of branches) and high heritability estimates for vine length (96.05 %), number of leaves (90.30%), number of branches (90.00 %) and tuber yield (75.90 %) and comparatively low for number of tubers (45.50 %). Out of these traits, number of tubers, tuber width and tuber weight showed high genetic association with yield.

Alam *et al.* (1998) studied on 15 genotypes of sweet potato and observed that the higher genotypic and phenotypic coefficients of variation were recorded for number of branches, number of tubers per plant, yield per plant, number of leaves and vine length. They also reported that high heritability along with high or moderate genetic advances for all the characters except tuber length.

Choudhary *et al.* (1999) conducted a study on fifty genotypes of sweet potato and found that a wide difference of phenotypic and genotypic co-efficient of

variations were observed for the vine length and root yield.

Vimala and Lakshmi (1999) obtained low heritability estimates for vine length and high heritability estimates for tuber length, tuber weight, number of branches, tuber girth and vine weight. They envisaged that genetic variance was relatively more important than non additive genetic variance for these characters.

Hossain *et al.* (2000) evaluated 30 genotypes of sweet potato and observed high phenotypic and genotypic coefficients of variation for number of tubers per plant, average tuber weight and tuber yield per plant. Estimates of heritability and genetic advance were highest for tuber yield per plant, average tuber weight and number of tubers per plant.

Sankari *et al.* (2001) evaluated fifteen genotypes of sweet potato and reported that the genotypic coefficient of variation was high for traits viz., yield of roots per vine, length of vine and girth of vine and observed high heritability coupled with high genetic advance for vine length, vine girth and yield per vine.

Teshome *et al.* (2004) studied 86 genotypes of sweet potato and observed that characters viz., number of branches per plant, weight of single tuber, girth of tuber, and vine traits like length of tuber, length of vine, weight of foliage per plant, number of tubers per plant and weight of single tuber showed higher phenotypic and genotypic coefficients of variation with high heritability estimates.

Sharma (2004) reported that the highest estimate of genetic advance as per cent of mean was obtained from tuber yield per plant, vine weight per plant, marketable tuber yield per plant, neck length of tuber, total soluble solids and vine length.

Studies conducted on 30 genotypes of sweet potato by Engida *et al.* (2007) revealed that the above ground fresh and dry weights, vine length, individual storage root weight, storage root fresh yield per plot, vine internodal length, storage root fresh yield per plant, leaf area and storage root number exhibited high genotypic coefficient of variation coupled with high heritability.

Gin *et al.* (2008) conducted a study on 30 genotypes of sweet potato and observed that GCV was highest for vine growth rate (65.38%) 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%), tuber length (26.69%) and tuber diameter (20.26%).

Shashikanth *et al.* (2008) conducted a study on 15 sweet potato genotypes and observed that the phenotypic and genotypic coefficients of variation were found to be moderate to high for all the characters *viz.*, vine inter nodal length, number of branches per plant, number of leaves, total leaf area except length of vine. They also observed that high heritability with high genetic advance as per cent of mean for all the characters except leaf area.

Choudhary and Mishra (2011) studied twelve genotypes of sweet potato and revealed that characters like vine length, number of tubers per plant and weight of tubers per plant exhibited high heritability coupled with high genetic advance.

Anuj. K.C. and Singh, A.K. (2013) evaluated the genetic parameters of seven orange fleshed sweet potato genotypes and reported high PCV, GCV and high heritability for vine length, number of tubers per plant, weight of the tuber per plant, dry matter content and marketable tuber yield and moderate PCV, GCV and moderate heritability.

Thiyagu *et al.* (2013) estimated the nature and magnitude of variability among morphology, yield and yield components of twenty-two sweet potato genotypes and observed greater PCV and GCV for all the yield and yield component characters except for shoot dry matter with values of 11.23 and 11.50%.

Muluken, D. and Abiyot, A. (2016) estimated the association of agro-morphological traits in sweet potato genotypes and revealed that tuber yield ranged from 123.67 q to 370.04 q with a mean of 231.04 q/ha, while root weight 100 g to 263 g with a mean of 168.04 g and found sweet potato variety Ma'e with highest tuber yield. Genotypic coefficient of variation and phenotypic coefficient of variation was recorded for unmarketable tuber yield of 33.93 % and 39.36 % respectively. They also reported heritability in a broad sense ranged between 4.99% (stand count at sprout) to 86.45% (vine inter nodal length). Genetic advance as per cent mean ranged from 7.42% (stand count at harvest) to 60.27 (unmarketable tuber yield).

Babu Rao *et al.* (2015) evaluated 18 cassava genotypes and reported that high magnitude of PCV and GCV were observed for the number of leaves per plant, total leaf area, height of first branching and HCN content. Further suggested that, the existence of wide range of genetic variability in the germplasm for these traits and thus the scope for improvement of these characters through simple selection was proved better. High heritability estimates coupled with high estimates from genetic

advance as per cent of mean were observed for the number of leaves per plant, total leaf area, height of first branching, stem diameter, tuber dry matter content, starch content, HCN content and tuber yield per hectare indicated that the heritability is due to additive gene effect.

Pankaj Singh *et al.* (2018) evaluated thirty six diverse genotypes of sweet potato and found the high genotypic coefficient of variance and phenotypic coefficient variance for number of branches per vine followed by internodal length, length of vine, number of leaves per vine, girth of tuber. They also reported that high heritability coupled with high GAM for number of branches per vine, internodal length, length of vine, number of leaf per vine, average weight of tuber, number of tubers per vine, TSS and width of leaf.

Ratna *et al.* (2019) evaluated 30 genotypes of sweet potato germplasm to find out information about genetic diversity and heritability and found that the weight of large storage root, number of large storage roots, storage root length, storage root diameter, vine length, segment length, vine diameter and weight of vines exhibited high genetic diversity and high heritability.

High GCV and PCV were observed for leaf area, tuber weight, dry weight of vine, total tuber yield per vine, total tuber yield per plot and marketable yield per hectare and also high heritability coupled with high GAM were recorded for the characters viz., vine length, number of leaves per vine, internodal length, vine girth, chlorophyll content, leaf area, tuber length, tuber girth, tuber weight, dry weight of vine, total tuber yield per vine, total tuber yield per plot and marketable yield per hectare (Sharavati *et al.*, 2018).

Rahajeng *et al.* (2020) evaluated the genetic parameters of thirty sweet potato accessions and found high PGV, GCV and high broad sense heritability for the number and weight of roots per plant, weight of saleable and root yield, harvest index and dry matter content and also observed moderate heritability for weight of vines and weight of the non-saleable root.

Bililign *et al.* (2021) conducted a study to determine variability for yield and yield related traits in 24 orange fleshed sweet potato genotypes and revealed PCV values ranged from 22.10 % for mature leaf size to 118.30 % for unmarketable root yield. The GCV ranged from 20.60 % for root girth to 111.70 % for unmarketable root yield, moderate GCV for root girth (20.00 %) while the highest GCV were observed for traits such as unmarketable root yield, beta carotene content, skin color,

marketable root yield and total root yield with values of 111.70, 104.97, 98.70, 76.10, 75.40 and 72.60 % respectively. They further found high heritability coupled with high GAM for vine length, vine inter-node length, vine diameter, petiole length, mature leaf size, root length, root girth, above ground fresh weight, harvest index, root dry matter content, beta carotene content, skin colour, flesh colour, number of roots per plant, marketable root yield, unmarketable root yield and total storage root yield.

Ashish Narayan *et al.* (2022) evaluated 20 genotypes of colour fleshed sweet potato for fourteen morphological characters and observed phenotypic coefficient of variation was more than genotypic coefficient of variation for all the characters studied and also reported high heritability estimates coupled with high genetic advance as percent of means for characters like vine length, leaf area index, number of tubers per plant, tuber yield per plant, average tuber weight, tuber girth, biological yield per plant and harvest index.

Pallavi Wani *et al.* (2022) evaluated sixteen orange fleshed sweet potato genotypes and reported higher magnitude of GCV and PCV for the number of leaves per vine, leaf area, mean weight of tuber, tuber yield per vine, tuber yield per plot and tuber yield per hectare. Further, they also reported high heritability coupled with high GAM for the characters viz., 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 per cent and beta carotene content.

Tessema *et al.* (2022) reported mean values of tuber yield, specific gravity, dry matter content, starch content and total starch yield for the variety 'Belete' while the lowest mean value of all these traits was recorded for the variety 'Menagesha'. They also reported PCV and GCV for specific gravity and total starch yield of the different potato genotypes studied ranged between (0.71% to 35.23% and 0.62% to 34.51%), respectively. The highest GAM was recorded for starch content, total and marketable tuber yields, plant height and the number of stems per hill.

Kar *et al.* (2022) conducted an experiment with fifteen genotypes of sweet potato and found high PCV and GCV for characters like vine internodal length, number of branches per plant, number of leaves per plant, total leaf area, number of roots per plant, root yield per plant, β -carotene content, starch content, total sugars, reducing sugars, non reducing sugars and total root yield per hectare content. They

further also reported high heritability coupled with high GAM for the number of branches per vine, number of leaves per vine, number of tubers per vine, tuber weight, tuber length, tuber girth, tuber yield per vine, tuber yield per plot and tuber yield per hectare.

Harriman *et al.* (2023) estimated high PCV for beta carotene (183.50 %), root yield per hectare (151.60 %), total root weight per plant (150.60 %) and total number of roots per plant (113.50 %) in 47 orange fleshed sweet potato genotypes and high for days to 50% flowering (373.16%), dry matter (220.30%), root girth (140.73 %), root length (68.10 %) and root yield per hectare (349.66 %). They further reported high heritability estimates for all the characters studies.

2.5 CORRELATION STUDIES

Correlation, measured by a correlation coefficient is important in plant breeding because, it measures the degree of association, genetic or non-genetic between two or more characters. If genetic association exists, selection for one trait will cause changes in other traits called the correlated response. The cause of correlation can be genetic and/or environmental. Genetic causes may be attributed to pleiotropism and linkage disequilibrium. When genes are not closely linked, linkage disequilibrium is not an important cause of correlation between characters in random mating populations. In such cases, the existence of genetic correlations is mostly attributable to pleiotropism (Hallauer and Miranda, 1982).

Tuber yield is one of the complex morphological characters and greatly influenced by various characters. Relationship among tuber yield and other associated characters could be obtained by simple correlation studies. Hence, correlation coefficients have got immense practical value in revealing the magnitude of relationship between different characters. Estimation of genotypic and phenotypic correlation between various characters may provide information, which is necessary in a breeding programme 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 correlated response in several other traits.

Shikata (1980) conducted population studies on sweet potato and observed lack of correlation between root yield and starch content.

Saladaga, F.A. (1981) worked out correlations among yields and its components and observed that total yield was positively correlated with skin colour, leaf shape, stem length and diameter, internodal length and number of branches per stem in sweet potato.

Bacusmo and Carpana (1982) reported that leaf area index, crop growth rate, leaf angle of younger leaves, vine length, number of tubers per plant and mean root weight were positively correlated with root yield.

Bhagsari and Harman (1982) revealed that yield was positively associated with the harvest index in sweet potato.

Janssens (1982) claimed that tuber yield was positively correlated with average tuber weight and number of tubers per unit of ground area.

Maluf *et al.* (1983) reported that the genotypic correlation between root and vine traits was low.

Lin (1983) found that yield per plant was positively correlated with the yield per unit area, tuber dry weight, number of branches, number of large to intermediate tubers and the length of petiole.

Bourke, R.L. (1984) observed that tuber yield at the final sampling was very closely correlated with total dry weight per plant and number of tubers per plant.

Yoshida (1985) in a study of correlation between successive yield tests for agronomic characters in sweet potato observed that correlation coefficients were generally higher at more advanced stages of selection.

Naskar *et al.* (1986) revealed that in general genotypic correlations were higher than phenotypic correlations. The characters like number of branches, girth of tubers and length of tubers were found to have high positive correlations with yield, whereas the length of vine and internodal length were negatively correlated with yield.

Ibrahim K.K. (1987) observed that the root characters as a whole were more strongly correlated to the tuber yield than shoot characters.

Tiwari J.P. (1987) reported a positive correlation between root yield and the number of roots per plant and an average weight of roots per plant.

Gerpacio and Chujoy (1994) revealed that tuber yield of sweet potato was highly and positively correlated with root size and dry matter content of tuber.

Nanda, H.C. (1994) reported that the marketable tuber yield was positively correlated with number of tubers per plant while, it had non-significant association

with neck length.

Kumar *et al.* (1996) observed that the tuber yield of sweet potato was highly and positively correlated with the number of tubers, tuber width and weight of the tuber.

Rajesh Kumar Jain and Ganguli (1996) conducted their studies on 25 genotypes and reported that number of tubers, tuber width and tuber weight had high genetic association with yield.

Amarchandra (1997) reported that number of tubers per plant, tuber length and tuber fresh weight were positively correlated with tuber yield.

Alam *et al.* (1998) studied fifteen genotypes of sweet potato and revealed that characters viz., tubers per plant, tuber width and weight of individual tuber were positively correlated with yield while vine length had a negative significant association with yield at both genotypic and phenotypic levels.

Parida *et al.* (1999) reported that marketable tuber yield and number of tubers per plant were significantly and positively correlated with tuber yield.

Choudhary *et al.* (2000) evaluated fifty genotypes of sweet potato and revealed that the total tuber yield had highly significant and positive phenotypic correlation with petiole length and tuber girth.

Hossain *et al.* (2000) evaluated 30 sweet potato genotypes and revealed that root yield was positively and significantly correlated with root diameter, average tuber weight and number of tubers per plant.

Perez *et al.* (2001) studied on eight sweet potato clones and resulted that tuber weight and total plant weight were significantly and positively correlated with yield.

Sahu *et al.* (2005) studied on 24 genotypes of sweet potato and concluded that tuber yield was positively and significantly correlated with biological yield per plant, tuber diameter and harvest index whereas vine weight per plant had a positive correlation with vine length.

Engida *et al.* (2006) conducted an experiment on 30 sweet potato genotypes and reported that storage root yield had a positive and significant correlation with individual storage root weight, harvest index and storage root girth whereas number of storage roots per plant was negatively and significantly correlated with individual storage root weight and storage root girth.

Shashikanth *et al.* (2008) reported that characters viz.,tuber diameter, tuber dry matter, starch and sugar content and fresh weight of vine were significantly and positively correlated with tuber yield in sweet potato.

Li Yun Song *et al.* (2010) studied 10 sweet potato genotypes and reported that the number of tubers per plant, number of branches per plant and number of green leaves per plant were significantly correlated with tuber yield.

Yohannes *et al.* (2010) reported a non-significant positive correlation for total storage root yield with root diameter, marketable storage root yield and average storage root weight and a highly significant positive genotypic correlation with unmarketable storage root yield.

Afuape *et al.* (2011) evaluated 18 land races of sweet potato along with three check varieties to estimate the nature and magnitude of variability existing among sweet potato germplasm and reported that significant positive correlation for tuber yield with vine length, number of vine branches, biggest roots length, medium roots length, smallest roots length, biggest root diameter, medium root diameter and smallest roots diameter.

Choudhary and Mishra (2011) conducted studies on 25 genotypes and revealed that number of tubers per plant exhibited significant positive correlation with marketable tuber yield.

Tirkey *et al.* (2011) revealed that tuber yield showed significant positive correlation with vine weight at both genotypic and phenotypic level.

Anuj, K.C. and Singh, A.K. (2013) observed significant and positive genotypic correlation for marketable tuber yield with numbers of tubers per plant, weight of tuber per plant and dry matter, while vine length exhibited negative correlation with marketable tuber yield.

Babu Rao *et al.* (2015) disclosed that numbers of leaves per plant, total leaf area, stem diameter, tuber diameter, plant dry matter content, starch content, HCN content had significant and positive association with tuber yield per hectare at both phenotypic and genotypic levels in cassava genotypes.

Muluken, D. and Abiyot, A. (2016) evaluated seven sweet potato genotypes, investigated association of agro-morphological traits in sweet potato genotypes and revealed that root tuber yield had positive and highly significant correlation with vine length, number of roots per plant, unmarketable root yield and marketable root yield at both phenotypic and genotypic levels. Further, non significant negative correlation

with stand count and vine inter nodal length. While number of branches per plant, stand count at harvest, green top weight, vine inter nodal diameter and root weight had positive and non significant correlation coefficient with root tuber yield at phenotypic level.

Chikoti *et al.* (2016) conducted correlation studies in 16 cassava genotypes and reported that fresh root yield was significantly and positively correlated with total fresh biomass, harvest index, leaf retention and root size. A positive and significant correlation was also observed between harvest index and root size. Cassava mosaic disease was significantly and positively correlated with plant height, total biomass and fresh root yield.

Pankaj Singh *et al.* (2018) evaluated thirty six diverse genotype of sweet potato and observed significant positive correlation for tuber yield per hectare followed by tuber weight, internodal length, specific gravity and tuber length with tuber yield per plant while, TSS and moisture content showed significant negative correlation with tuber yield per plant.

Ratna *et al.* (2019) evaluated 30 genotypes of sweet potato germplasm to find out the association between yield attributing characters and observed that the characters of the weight of large storage root, storage root length and storage root diameter were positively correlated with the weight of the storage root whereas, the length of vines is negatively correlated with the weight of large storage.

2.4 PATH COEFFICIENT ANALYSIS

The observed correlation between yield and the yield contributing characters is the net result of the direct effect of the yield component and the indirect effect through other yield attributing characters.

The total correlation between grain yield and its component characters may sometimes be misleading. Since, it may be over or under estimate of its association with other characters. Hence, direct selection on correlated response basis may not be worthwhile. The correlation coefficient needs to be split into direct and indirect effects, using path coefficient analysis for critical evaluation as many characters effect a given trait. Thus, the correlation and path analysis in combination can give a better insight into cause and effect relationship between different pairs of characters. As a guideline for interpretation of path analysis results, the following broad points

may be kept in view (Singh and Chaudhary, 1977).

- ❖ If the correlation coefficient between a causal factor and the effect is almost equal to its direct effects, then correlation explains the true relationship through this trait will be effective.
- ❖ If the correlation coefficient is positive, but the direct effect is negative or negligible, the indirect effects seems to be cause of positive correlation. In such situations, the indirect causal factors are to be considered simultaneously for selection.
- ❖ Correlation coefficient may be negative but the direct effect is positive and high. Under these circumstances, a restricted simultaneous selection model is to be followed *i.e.* restrictions to be imposed to nullify the undesirable indirect effects in order to make use of the direct effect.
- ❖ If the correlation coefficient is negative and direct effect is also negative, then we have to drop the selection based on that character.
- ❖ The residual effect determines how best the causal factors account for the variability of the dependent factor. If residual effect is high, some other factors, which have not been considered here, need to be included in this analysis to account fully for the variation in yield.

Choudhary *et al.* (2000) evaluated the genetic parameters of fifty genotypes of sweet potato and revealed that total tuber yield showed direct effect on total tuber yield per plant and marketable tuber yield. Hossain *et al.* (2000) evaluated thirty sweet potato genotypes and concluded that average tuber weight and number of tubers per plant had a positive direct effect on tuber yield.

Sahu *et al.* (2005) investigated the interrelationship of yield and its components of 24 sweet potato genotypes and revealed that the number of marketable tubers had a direct positive effect on tuber yield, whereas vine weight had a positive indirect effect on tuber yield *via* tuber yield per plant and marketable tuber yield. Neck length of the tuber, tuber length, 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.

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

Regassa and Basavaraj (2007) investigated path coefficient analysis in 100 accessions revealed that 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.

Sattar *et al.* (2007) observed that average weight of tuber and total number of tubers per plant contributed the maximum direct effect to tuber yield indicating their importance as selection index for yield improvement. Shashikanth *et al.* (2008) revealed that number of tubers had a direct association with tuber yield. Ara *et al.* (2009) revealed that number of shoots showed highest positive direct effect on tuber yield followed by fresh weight of plant at 80 days after planting and number of leaves per plant.

Mondal *et al.* (2009) revealed that 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 had a direct positive influence on tuber weight per plant in potato.

Path analysis studies in edible cassava germplasm revealed that tuber weight followed by plant height had a maximum positive direct effect on tuber yield. Therefore emphasis should be given on tuber weight, plant height and also tuber width while selecting a good genotype for enhancing the yield of cassava (Padma *et al.*, 2009).

Study on twelve sweet potato genotypes revealed that a number of tubers per plant exhibited a highly significant direct effect on tuber yield (Choudhary and Mishra., 2011).

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

Study on path co-efficient analysis revealed that biological yield per plant was important trait influencing tuber yield in sweet potato (Jha, 2012).

Anuj, K.C. and Singh, A.K. (2013) studied the inter relationship of tuber yield and its component characters of seven orange fleshed sweet potato genotypes and reported that number of tubers per plant, tuber weight per plant showed a high positive direct effect and root dry matter content and harvest index showed high and moderate negative direct effect on tuber yield respectively.

Okpara *et al.* (2013) studied the path analysis of fresh root yield of high and low cyanide cassava cultivars. The results showed that the average weight of the root had the highest direct effect in high and in low cyanide cassava genotypes. Also, the number of roots per plant in both types of cassava exerted a positive direct effect on fresh root yield, however, a minimum effect was obtained by the number of leaves per plant in high-cyanide cassava genotypes and number of stems per plant in low cyanide cassava genotypes.

Patel *et al.* (2013) conducted path coefficient analysis for plant height, number of stems per plant, number of tubers per plant, average weight of tubers, tubers dry matter, total tuber yield and marketable yield and reported that a higher positive direct effect on total tuber yield for marketable yield.

Ummiyah *et al.* (2013) studied path coefficient analysis for yield and its contributing characters. The average tuber weight exerted a highest positive direct effect on tuber yield per plant followed by a number of tubers per plant, stolon length and plant height suggesting that these traits were the strongest forces influencing tuber yield in potato.

Study on path analysis between yield and yield components in cassava was conducted by Kundy *et al.* (2014) and revealed that path analysis of roots per plant, plant height and root size had highest direct influence.

Babu Rao *et al.* (2015) conducted an experiment on 18 cassava accessions to study the path analysis of yield components and reported that number of leaves per plant, stem diameter, number of tubers per plant, tuber diameter and plant dry matter content exerted positive and direct effects on marketable yield per plant.

Singh *et al.* (2015) revealed that marketable tuber yield per hectare, number of shoots per plant, dry weight of shoots per plant, plant height, number of leaflets per plant, number of tubers per plant had high positive and direct influence on total tuber yield.

Verma and Singh (2015) conducted a study on path coefficient analysis among forty-eight potato genotypes including four checks and evaluated for nine morphological traits and found that marketable yield per plot, number of tuber per plant, plant height and tuber yield per plant had a highest positive direct effect on total tuber yield.

A study on path co-efficient analysis on morphological and yield attributing characters of taro was conducted by Mukherjee *et al.* (2016) and revealed that weight of cormels per plant possessed the highest direct effect on tuber yield indicating the importance of selection based on this character to increase tuber yield per plant.

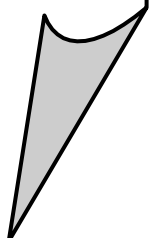
Mishra *et al.* (2017) studied the path coefficient analysis for important yield component characters in potato and revealed that positive and direct effect of the fresh

weight of tubers, followed by plant canopy cover percentage, number of tubers, dry weight of shoots and number of leaves on total tuber yield.

Path analysis study in cassava genotypes was conducted by Babu Rao *et al.* (2017) revealed that stem diameter and tuber diameter exerted a high positive direct effect on tuber yield. The direct effect of these traits appeared to be the main factor for their strong association with tuber yield per hectare.

Pankaj Singh *et al.* (2018) studied path coefficient analysis in sweet potato genotypes and revealed that, tuber weight followed by tubers per vine, tuber yield per plant showed a higher value of positive direct effect on tuber yield per plant while, tuber yield followed by specific gravity via tuber weight and branches per vine, length of vine and leaves per vine via tuber per vine, vine length and leaves per vine showed positive indirect effect on tuber yield per plant.

Material and Methods... ✎



CHAPTER III

MATERIAL AND METHODS

A field experiment was carried out during the *rabi* season of 2022-23, to study the performance of various orange-fleshed sweet potato (*Ipomea batatas* L.) genotypes. The details regarding the material used and methods adopted and statistical procedures followed during the course of work are described in this chapter.

3.1 Location of Experimental Work:

The field experiment was carried out in an experimental farm, Department of Horticulture AAU, Jorhat, Assam, during the *rabi* season of 2022-2023. The experimental site is located at 26°47' N latitude, 94°12' E longitude and located at an altitude of 86.80 meters above the mean sea level.

3.2 Climate and weather conditions:

The Jorhat district is located in the upper Brahmaputra valley zone (UBVZ) of Assam which often enjoys subtropical weather, with humid summers and cool winters. The monsoon season usually begins in the first week of June, lasts till September and then withdraws by October, with pre-monsoon precipitation commencing in February. The average annual precipitation is 204.20±cm. Because of its subtropical location, the region gets high relative humidity (over 80%). In general, the highest temperature is above 37°C in July and August, while the lowest temperature is below 5-7°C in the first week of January. This is a broad tendency in terms of the district's meteorological conditions.

The metrological observation as recorded during the period of the experiment is presented in appendices.

3.3 Experimental details

3.3.1 Experimental material

The experimental material comprised of fourteen orange fleshed sweet potato genotypes were procured from Dr. YSRHU Horticultural Research Station, AICRP on Tuber Crops, Peddapuram, A.P., AICRP on Tuber Crops, Assam Agricultural University, Jorhat, Assam and CTCRI, Thiruvananthapuram. The genotypes used for the experiment are presented in Table 1.

Table 1: Genotypes of orange-fleshed sweet potato

Genotype	Name of the genotype	Source
1	Bhu Ja	AICRP TC
2	Dergaon Red	AICRP TC
3	Gouri	AICRP TC
4	TSP 16-3	AICRP TC
5	CIPSAW-2	AICRP TC
6	Kamala Sundari	AICRP TC
7	PSP-1	AICRP TC
8	TSP 16-7	AICRP TC
9	S1156	AICRP TC
10	Bhu kanti	AICRP TC
11	Bhu Sona	CTCRI
12	Kiran	AICRP TC
13	Co-1	AICRP TC
14	TSP 16-9	AICRP TC

3.3.2 LAYOUT OF THE EXPERIMENT

The experiment was laid out in a Randomized Block Design with fourteen genotypes replicated twice. Fifty-two healthy vine cuttings of each genotype were planted in each plot in each replication.

Details of layout:

1. Crop : Orange fleshed sweet potato
2. Number of treatments (genotypes) : 14
3. Design : Randomized Block Design (RBD)
4. Replications : 2
5. Season : *Rabi*, 2022-23
6. Plot size : 3.5 m x 2.1m
7. Spacing : 70 cm x 20 cm
8. Number of plants per plot : 52

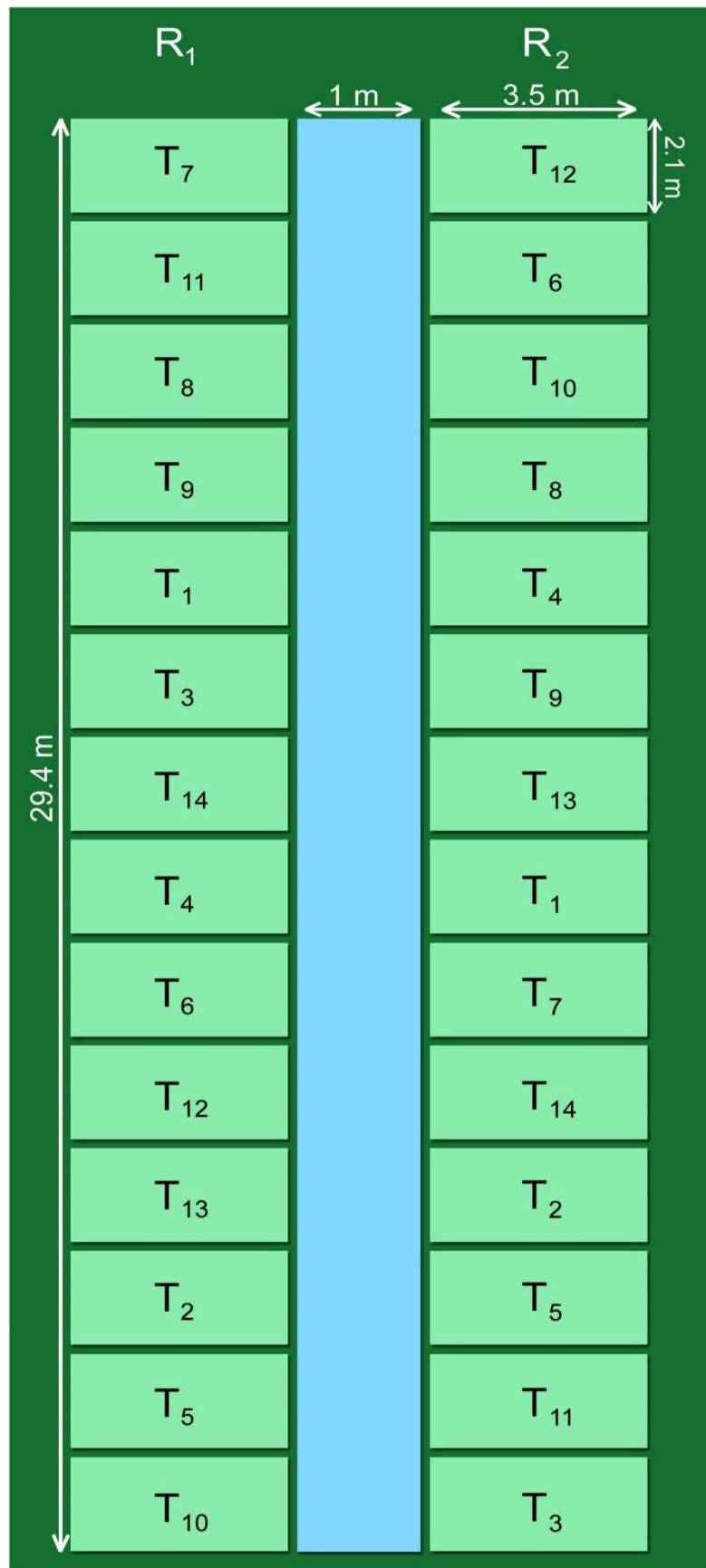


Fig:3.1 Layout of the Experimental Plot



PLATE 3.2: GENERAL VIEW OF THE EXPERIMENTAL PLOT

3.4 Characteristics of the soil

The soil was black sandy loam soils with good drainage and moderate water-holding capacity. The physical composition of the soil was; sand 64.31%, silt 18.54%, and clay 18.24%. The soil pH was 5.50 and the E.C. was 0.05 dSm^{-1} , available nitrogen was 314.00 kg/ha , available phosphorus was 24.60 kg/ha and available potassium was 119.00 kg/ha , while the available organic carbon of the soil was 0.46 %.

3.5 Cultural practices

The following sections provide information on the various cultural operations carried out during the course of the research.

3.5.1 Nursery

Well matured healthy and disease free cuttings of previous season of each genotype were used as planting material for the experiment. The cuttings, 20-30 cm in length were planted in primary nursery at a distance of 30 cm between rows and 20 cm in the row. Ultimately when the vines in primary nursery reach a sufficient length, the cuttings were made and planted in the secondary nursery. After one month, healthy cuttings of 20-30 cm in length with 3-4 nodes were planted in the main field.

3.5.2 Preparation of experimental field

The experimental field was thoroughly ploughed to a depth of 15-25 cm and brought to a fine tilth and the plots were put out according to the layout design. Size of the each plot was $3.5 \text{ m} \times 2.1 \text{ m}$. A spacing of 1.0 m was given between the replications and ridges and furrows were prepared.

3.5.3 Planting

When the nursery vines were developed sufficiently, healthy cuttings of 20-30 cm long with 3-4 nodes were planted in the main field. The cuttings taken from the apical and middle portions of the vine have been found to produce more sprouts and give high yield of tubers than basal cuttings (Nedunchezhiyan *et al.* 2008). The ridges and furrows were prepared at 70 cm apart and one cutting was planted on the ridge at 20 cm distance. The planting was done on 20th October 2022 during the *rabi* season.

3.5.4 Application of manures and fertilizers

Well decomposed FYM at the rate of 10 tonnes per hectare was applied at the time of land preparation along with a recommended dose of N:P:K (75:50:75 kg/ha) as per the package and practices standardized by AAU.

3.5.5 Intercultural operations

The experimental plot was kept weed-free by regular hand weeding and earthing-up operations, performed at 30-35 days after planting (DAP). At the initial stage of the crop growth regular irrigation was given and later on depending upon the soil moisture condition irrigation was given as and when required. Turning of vines was also performed at 55-60 DAP.

3.5.6 Harvesting

The tubers were harvested from the experimental plot by digging out carefully with spades and fork at 120 DAP.

3.6 OBSERVATIONS RECORDED

Data on the following characters were recorded from five randomly selected and tagged plants of each plot. Observations were recorded on selected tagged plants for different characters in each replication and then the average of the five plants was taken.

3.6.1 Growth parameters

3.6.1.1 Vine length

The length of the vine was recorded at 30, 60 and 90 days after planting and at harvest from ground level to the tip of the plant and was expressed in centimeters.

3.6.1.2 Internodal length

The internodal length was recorded at 30, 60 and 90 days after planting and at harvest. It is the ratio of length of the vine to number of nodes per vine and it was expressed in centimetres.

3.6.1.3 Vine weight

The weight of vine from five tagged plants was recorded and expressed in grams per plant during harvesting using a digital weighing scale and the average was recorded and expressed in grams.

3.6.1.4 Length of the tuber

Tuber length was measured in centimeters with the scale for five tubers from the five tagged plants and average length of the tubers was computed and expressed in centimeters.

3.6.1.5 Diameter of the tuber

The maximum diameter of the tuber was measured with vernier calipers in the central part of the tuber for five tubers per plant from the five tagged plants and average diameter of the tubers was computed and expressed in centimeters.

3.6.1.6 Fresh weight of the whole plant

The entire plant was harvested, cleansed of dirt particles and then weighed in grams by using an electric balance and expressed in grams.

3.6.1.7 Dry weight of the whole plant

The dry weight of the plant was determined by oven drying the entire plant for 21 to 48 hours at 70 °C until two constant weights were found similar. The dry weight was expressed in grams by using an electric balance.

3.6.1.8 Plant dry matter content (%)

Three plants at random from each genotype were lifted carefully with tubers at the time of harvest and the leaves, stems and tubers were separated, fresh weight of vein was recorded and air dried. Their weights were recorded after drying in oven at 70°C for 72 hours and the mean plant dry weight of samples was recorded and expressed in percentage.

3.6.1.9 Fresh weight of tubers (g)

The entire tubers were harvested, cleaned of dirt particles and then weighed in grams by using an electric balance.

3.6.1.10 Dry weight of tubers (g)

The dry weight of the tubers was determined by oven drying the entire tubers for five days at 70 °C until two constant weights were obtained similar. The dry weight was expressed in grams.

3.6.1.11 Tuber dry matter content (%)

Three plants at random from each genotype were lifted carefully with tubers at the time of harvest and the leaves, stems and tubers were separated, fresh weight of total tubers was recorded and air dried. Their weights were recorded after drying in oven at 70°C for 72 hours and the mean tuber dry weight of samples was recorded and expressed in percentage.

3.6.1.12 Tuber moisture content (%)

The initial weight of the randomly selected fresh tubers was recorded and then tubers were kept in oven for drying at 70°C and their dry weights were recorded after drying for 72 hours and the mean tuber dry weight of samples was recorded and the tuber moisture content was expressed in percentage by using the following formulae.

$$\text{Tuber moisture content (\%)} = \frac{W - D}{W} \times 100$$

Where,

W- Initial weight of the sample

D- Dry weight of the sample

3.6.1.13 Number of tubers per plant

The number of tubers of five plants was counted and the mean was expressed as the number of tubers per plant.

3.6.1.14 Total tuber yield per plant

The total tuber yield from each of the five tagged plants was weighed and stated in grams.

3.6.1.15 Total tuber yield per plant per hectare

The total tuber yield of all genotypes in each replication was recorded on plant population per hectare basis and calculated as unmarketable tuber yield per hectare and was expressed in tonnes per hectare.

3.6.1.16 Unmarketable tuber yield per plant

The weevil infested and very small tubers were sorted out from total tuber yield was recorded as unmarketable tuber yield per plant and expressed in grams.

3.6.1.17 Unmarketable tuber yield per hectare

The unmarketable tuber yield of all genotypes in each replication was recorded on plant population per hectare basis and calculated as unmarketable tuber yield per hectare and was expressed in tonnes per hectare.

3.6.1.18 Marketable tuber yield per plant

The weevil infested and very small tubers were excluded from the total tuber yield was recorded as marketable tuber yield per plant and expressed in grams.

3.6.1.19 Marketable tuber yield per hectare

The tuber yield (excluding weevil infested and very small tubers) of all genotypes in each replication was recorded on plant population per hectare basis and calculated as marketable tuber yield per hectare and was expressed in tonnes per hectare.

3.7.2 QUALITY TRAITS

3.7.2.1 Total Soluble Sugars (TSS)

A small amount of tuber flesh was crushed with a mortar and pestle and its juice was extracted by filtering it through a muslin cloth. The tuber's TSS was determined using a digital refractometer and expressed in °Brix.

3.7.2.2 Total carotenoids

A sample of five grams tuber was taken and crushed in 10 ml of acetone with the help of a mortar and pestle. Until the residue is colourless, the supernatant is decanted into a conical flask and the procedure was repeated. Then the supernatant was sent to a separating funnel where 10 ml of petroleum ether was added. Then, 25 ml of five percent anhydrous sodium sulphate solution was added, then shake the separating funnel. Then the mixture was left standing until two layers were formed. The bottom colourless layer was removed, keeping the coloured layer. To it again 10 ml of petroleum ether was added once again. Until the colour was transferred into the petroleum ether, 10 ml of petroleum ether was added to the acetone layer containing Na₂SO₄. The upper pigment-containing layer was collected in a 25 ml volumetric flask and the volume was made up to 25 ml by adding petroleum ether. Petroleum ether was used as a blank to read the optical density at 452 nm by using a spectrophotometer.

$$\text{Total Carotenoids} = \frac{3.857 * O.D * \text{Volume made up} * \text{Dilution}}{\text{Weight of sample} * 1000} * 100$$

3.7.2.3 Starch content (%)

The starch content was determined by using the method outlined by Mc Cready *et al.* (1950). A sample of 0.50 g of tuber flesh was taken and homogenized in hot 80% ethanol to remove sugar. Centrifuged the sample and retain the residue. Washed the residue repeatedly with hot 80% ethanol until no more green colour appears and then dried the residue well over a water bath.

Then added 5.0 ml of water and 82% perchloric acid in the residue. Extracted the residual sample at 0°C for 20 minutes. Centrifuged it and repeated the same procedure. Repeated the extraction using fresh perchloric acid centrifuged and pooled the supernatants and made up to 100 ml with water. Pipetted 0.1 ml of the supernatant and made up to 4 ml with water. Added 4ml anthrone and heated for 8 minutes on water bath then it was cooled rapidly. Read the density of green to dark green color at 630nm.

3.7.2.4 Total sugars (%)

Total sugars were determined by the method of Lane and Eyon (AOAC, 1965). Fifty milli litres of lead-free filtrate was taken into a 100 ml volumetric flask and 5 ml of concentrated HCL was added to it, mixed thoroughly and left at room temperature for 24 hours. The acid was then neutralized with NaOH while a drop of phenolphthalein was used as an indicator till the pink colour persisted for at least a few seconds. Then the volume was made upto 100 milli liters. Total sugars were thereafter determined by taking this solution in a burette and titrating it against a standard Fehling's solution mixture of A and B (1:1) with methylene blue as an indicator until a brick red colour was observed and noted as an end point.

$$\text{Total sugars \%} = \frac{\text{Factor X Volume made up}}{\text{Titre Value X Weight of sample}} \times 100$$

3.7.2.5 Reducing sugars (%)

Reducing sugars were determined by the method of Lane and Eyon (AOAC, 1965). Ten grams of sample was taken in a beaker, grounded well by using mortar and pestle. To it two milli litres of lead acetate solution (45%) was added followed by four milli litres of potassium oxalate (22%). Then the volume was made up to 100 ml using distilled water.

After checking a little amount of filtrate for lead freeness with a drop of potassium

oxalate, the contents were filtered using Whatmann No.1 filter paper. The lead-free solution was transferred in a burette and titrated against 10 ml of standard Fehling's solution mixture A and B (1:1) using methylene blue as an indicator until a brick red precipitate appeared and the end point was recorded. Fehling's solution was kept boiling on the heating mantle during the titration.

$$\text{Reducing sugars \%} = \frac{\text{Factor} \times \text{Volume made up}}{\text{Titre Value} \times \text{Weight of sample}} \times 100$$

3.7.2.6 Non-reducing sugars (%)

Non reducing sugar in a sample is obtained by subtracting reducing sugar from total sugars.

$$\text{Non reducing sugars (\%)} = \text{Total sugars} - \text{Reducing sugars}$$

3.7.2.7 Shelf life

The shelf life of tubers was determined based on their storage ability and marketability. When the tubers shrivelled and start to sprout after they had passed the edible stage, they were regarded to have reached the end of their shelf life (Turner, 1997).

3.8 STATISTICAL ANALYSIS

The compiled mean values of five plants for each character for each genotype in each replication were statistically analyzed using OPSTAT software.

3.8.1 Analysis of variance (ANOVA)

To determine the significance of the genotype effect, data were analyzed using the procedures outlined by Panse and Sukhatme (1985) using the mean values of random plants in each replication from all genotypes.

The analysis of variance table model that was used is presented below. The data for various characters were statistically analyzed according to the methodology proposed by Cochran and Cox (1950) for randomised block design.

$$Y_{ij} = \mu + b_i + t_j + e_{ij}$$

Where,

Y_{ij} = Performance of the j^{th} genotype in the i^{th} block

μ = general mean

b_i = true effect of i^{th} block

t_j = true effect of j^{th} genotype

e_{ij} = random error associated with i^{th} block and j^{th} genotype

The analysis of variance for each character was carried out as indicated below:

Sources of variation	Df	SS	MSS	F ratio
Replications	$r-1$	RSS	RMSS	$\text{RMSS}/E_r\text{MSS}$
Treatments	$t-1$	$T_r\text{SS}$	$T_r\text{MSS}$	$T_r\text{MSS}/E_r\text{MSS}$
Error	$(r-1)(t-1)$	$E_r\text{SS}$	$E_r\text{MSS}$	
Total	$(rt-1)$	TSS		

Where,

r = Number of replications

t = Number of genotypes or treatments

df = degrees of freedom

SS = sum of squares

MSS = Mean sum of squares

RSS = Replication Sum of squares

$T_r\text{SS}$ = Treatment sum of squares

$E_r\text{SS}$ = Error sum of squares

TSS = Total sum of squares

RMSS = Mean sum of squares due to replications

$T_r\text{MSS}$ = Mean sum of squares due to treatments

$E_r\text{MSS}$ = Mean sum of squares due to error

The test of significance was carried out against the corresponding error degrees of freedom by using 'F' table values given by Fisher and Yates (1963).

Critical difference (C.D)

To compare the means for various entries, CD was calculated using the formula,

Critical difference (CD) = S.E (d) x t

$$S.E (d) = \sqrt{\frac{2 \times \text{error MSS}}{r}}$$

Where,

t = is the table value at 5 per cent or 1 per cent probability level, respectively

r = number of replications

3.9 ESTIMATION OF GENETIC PARAMETERS

The genetic parameters such as genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in broad sense and genetic advance for different characters were worked out by following the standard procedures for all the genotypes under study.

3.9.1 Genotypic and phenotypic coefficients of variation

Genotypic and phenotypic coefficients of variation were estimated according to Burton and Devane (1953) by using the following formulae

$$\text{Phenotypic standard deviation } (\sigma_p) = \sqrt{\sigma_g^2 + \sigma_e^2}$$

$$\text{Genotypic standard deviation } (\sigma_g) = \sqrt{\sigma_g^2}$$

$$PCV = \frac{\sqrt{\sigma_p^2}}{\bar{X}} \times 100$$

$$GCV = \frac{\sqrt{\sigma_g^2}}{\bar{X}} \times 100$$

Where,

$$\sigma_g^2 = \text{Genotypic variance} = \frac{T_e \text{MSS} - \text{EMSS}}{r}$$

$$\sigma_e^2 = \text{Environment variance} = \frac{\text{EMSS}}{r}$$

$$\sigma_p^2 = \text{Phenotypic variance} = \sigma_g^2 + \sigma_e^2$$

$\bar{X}$ = General mean

Categorization of PCV and GCV based on the range of variation as reported by Sivasubramanian and Menon (1973) was followed.

Low = 0-10 %

Moderate = 11- 20 %

High = more than 21 %

3.9.2 Heritability in Broad sense [h^2 (b)]

Heritability in broad sense was estimated as per the formulae as suggested by Allard (1960).

$$h^2(b) = \frac{\sigma_g^2}{\sigma_p^2} \times 100$$

Where,

$h^2(b)$ = Heritability estimates in broad sense

σ_g^2 = Genotypic variance

σ_p^2 = Phenotypic variance

As suggested by Johnson *et al.* (1955), $h^2(b)$ estimates were categorised as

Low = 0-30 %

Medium = 31-60 %

High = 61 % and above

3.9.3 Genetic advance (GA)

This was estimated as per the formula proposed by Lush (1940) and Johnson *et al.* (1955).

$$GA = K \times \sigma_p \times h^2(b)$$

Where, K = Selection differential at 5 per cent selection intensity which accounts to a constant value 2.06

$h^2(b)$ = Heritability in broad sense

σ_p = Phenotypic standard deviation

3.9.4 Genetic advance as per cent of mean (GAM)

Genetic advance over mean (GAM) was calculated using the following formula and was expressed in percentage.

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

Where, GA = genetic advance

$\bar{X}$ = general mean of the character

The genetic advance as per cent over mean was categorized as suggested by Johnson *et al.* (1955) and is mentioned below:

Low = 0-10 %

Moderate = 11-20 %

High = 21 % and above

3.10 CORRELATION STUDIES

Phenotypic and genotypic correlations were worked out by using formula suggested by Falconer (1964).

Phenotypic coefficient of correlation (r_p)

$$r(x_i, x_j)_p = \frac{\text{COV}(x_i, x_j)_p}{\sqrt{V(x_i)_p \cdot V(x_j)_p}}$$

Where,

$r(x_i, x_j)_p$ = Phenotypic correlation between i^{th} and j^{th} character

$\text{COV}(x_i, x_j)_p$ = Phenotypic covariance between i^{th} and j^{th} character

$V(x_i)_p$ = Phenotypic variance of i^{th} character

$V(x_j)_p$ = Phenotypic variance of j^{th} character

Genotypic coefficient of correlation (r_g)

$$r(x_i, x_j)_g = \frac{\text{COV}(x_i, x_j)_g}{\sqrt{V(x_i)_g \cdot V(x_j)_g}}$$

Where,

$r(x_i, x_j)_g$ = Genotypic correlation between i^{th} and j^{th} character

$\text{COV}(x_i, x_j)_g$ = Genotypic covariance between i^{th} and j^{th} character

$V(x_i)_g$ = genotypic variance of i^{th} character

$V(x_j)_g$ = genotypic variance of j^{th} character

Test of significance

Significance of correlation coefficients was tested by comparing phenotypic correlation coefficients with the table values (Fisher and Yates, 1963) at $(n-2)$ degrees of freedom at 5 % and 1 % level, where 'n' denotes the total number of pairs of observations used in the calculation.

$$t = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}}$$

t = test of significance

r = correlation coefficient

n = number of paired observations

3.11 Path Coefficient Analysis

Path coefficient analysis suggested by Wright (1921) and elaborated to Dewey and Lu (1959) was used to calculate the direct and indirect contribution of various traits to yield.

For estimation of various direct and indirect effects, a set of simultaneous equations were formed:

$$\begin{aligned} r_{1y} &= P_{1y} + r_{12} P_{2y} + r_{13} P_{3y} + \dots + r_{1k} P_{ky} \\ r_{2y} &= r_{21} P_{1y} + P_{2y} + r_{23} P_{3y} + \dots + r_{2k} P_{ky} \\ r_{iy} &= r_{i1} P_{1y} + r_{i2} P_{2y} + r_{i3} P_{3y} + \dots + r_{ik} P_{ky} \\ r_{ky} &= r_{k1} P_{1y} + r_{k2} P_{2y} + r_{k3} P_{3y} + \dots + r_{kk} P_{ky} \end{aligned}$$

Where,

r_{1y} to r_{ky} = Coefficient of correlations between causal factors 1 to K and dependent character Y.

r_{12} to $r_{k-1,k}$ = Coefficient of correlations among causal factors.

P_{1y} to P_{ky} = Direct effects of characters 1 to k on character y

The above equations were written in a matrix form as under:

$$\begin{array}{ccc}
 \text{A} & & \text{C} & & \text{B} \\
 \left[\begin{array}{c} r_{1y} \\ r_{2y} \\ . \\ . \\ r_{ky} \end{array} \right] & = & \left[\begin{array}{cccccc} 1 & r_{12} & r_{13} & . & . & . & r_{1k} \\ r_{21} & 1 & r_{23} & . & . & . & r_{2k} \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ r_{k1} & r_{k2} & r_{k3} & . & . & . & 1 \end{array} \right] & \left[\begin{array}{c} P_{1y} \\ P_{2y} \\ . \\ . \\ P_{ky} \end{array} \right]
 \end{array}$$

or $A=BC$

$C = B^{-1} A$ inverse of matrix 'B' obtained by elimination procedure or through Adjoint method.

$$\text{Then } (B)^{-1} = \left[\begin{array}{cccccc} C_{11} & C_{12} & . & . & . & C_{1k} \\ C_{21} & C_{22} & . & . & . & C_{2k} \\ . & . & . & . & . & . \\ C_{k1} & C_{k2} & . & . & . & C_{kk} \end{array} \right]$$

Then direct effects were calculated as follows,

$$P_{1y} = \sum_{i=1} C_{1i}.r_{iy}$$

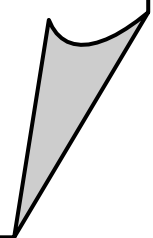
$$P_{2y} = \sum_{i=1} C_{2i}.r_{iy}$$

$$P_{ky} = \sum_{i=1} C_{ki}.r_{iy}$$

Lenka and Mishra (1973) have suggested a scale for the importance of direct and indirect effects values as given below:

1.00 and above	=	Very high
0.30 to 0.99	=	High
0.20 to 0.29	=	Moderate
0.10 to 0.19	=	Low
Below 0.10	=	Negligible

Experimental findings... 



CHAPTER IV

EXPERIMENTAL FINDINGS

An experiment entitled ‘Performance of orange-fleshed sweet potato (*Ipomea batatas* L.) genotypes for yield and yield attributing characters’ was carried out at an Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during the year 2022-2023. Observations were recorded on different quantitative parameters viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%), tuber moisture content (%), length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, total tuber yield per plant (g), total tuber yield per hectare (t/ha), unmarketable tuber yield per plant (g), unmarketable tuber yield per hectare (t/ha), marketable tuber yield per plant (g), marketable tuber yield per hectare (t/ha) and qualitative parameters like total soluble solids (°Brix), total carotenoids (mg/100g), starch (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days). The data were subjected to statistical analysis to get information regarding quantitative and biochemical variability among the fourteen genotypes. The experimental findings are presented in this chapter under different sub-heads.

4.1 Morphological characters

4.2 Quality parameters

4.3 Genetic variability

4.4 Correlation coefficient analysis

4.5 Path coefficient analysis

4.1 MORPHOLOGICAL CHARACTERS

The data pertaining to quantitative parameters of different orange-fleshed sweet potato genotypes were presented in Tables 4.1 to 4.7.

4.1.1 Vine length (cm)

The mean vine length (cm) of different genotypes was presented in Table 4.1. A significant difference ($p \leq 0.05$) was observed in vine length among different genotypes of OFSP at 30, 60, 90 and 120 DAP. On the 30th day, among all the genotypes TSP 16-3 recorded the maximum vine length (114.70 cm), while Bhu Ja recorded the minimum vine length (34.00 cm). On the 60th day, among all the genotypes TSP 16-3 recorded the maximum vine length (194.00 cm), while Bhu Ja recorded the minimum vine length (40.40 cm). On the 90th day, among all the genotypes TSP 16-3 recorded the maximum vine length

(199.80 cm), while Bhu Ja recorded the minimum vine length (45.20 cm). On the 120th day, among all the genotypes TSP 16-3 recorded the maximum vine length (225.20 cm), while Bhu Ja recorded the minimum vine length (61.30 cm).

Table. 4.1 Mean performance of orange-fleshed sweet potato genotypes for vine length

S. No.	Name of the genotype	Vine length (cm)			
		30 days	60 days	90 days	120 days
1	Bhu Ja	34.00	40.40	45.20	61.30
2	Dergaon Red	58.80	85.80	94.00	100.60
3	Gouri	53.90	68.90	77.80	81.50
4	TSP 16-3	114.70	194.00	199.80	225.20
5	CIPSWA-2	51.30	96.50	107.60	118.60
6	Kamala Sundari	63.50	93.90	110.20	123.20
7	PSP-1	79.90	98.80	119.70	122.80
8	TSP 16-7	69.20	92.80	119.90	129.70
9	S1156	65.90	93.60	107.70	150.20
10	Bhu Kanti	38.40	84.30	99.20	114.70
11	Bhu Sona	73.00	102.10	118.50	136.30
12	Kiran	54.90	75.40	80.60	90.90
13	Co-1	45.40	58.80	65.90	76.10
14	TSP 16-9	81.10	134.40	180.10	193.40
Gm		63.14	94.92	109.01	123.17
SEm(±)		1.77	1.83	2.69	4.86
CD at 5%		5.41	5.60	8.24	14.86

4.1.2 Internodal length (cm)

The mean internodal length (cm) of different genotypes was presented in Table 4.2. A significant difference ($p \leq 0.05$) was observed in internodal length among different genotypes of OFSP at 30, 60, 90 and 120 DAP. On the 30th day, among all the genotypes, TSP 16-3 recorded the maximum internodal length (5.82 cm), while Dergaon Red recorded the minimum internodal length (2.15 cm). On the 60th day, among all the genotypes, TSP 16-3 recorded the maximum internodal length (8.07cm), while Bhu Ja recorded the minimum internodal length (2.75 cm). On the 90th day, among all the genotypes, TSP 16-3 recorded the maximum internodal length (10.98 cm), while Co-1 recorded the minimum internodal length (3.35 cm).

On the 120th day, among all the genotypes, TSP 16-3 recorded the maximum internodal length (11.91 cm), while CIPSWA-2 recorded the minimum internodal length (3.66 cm).

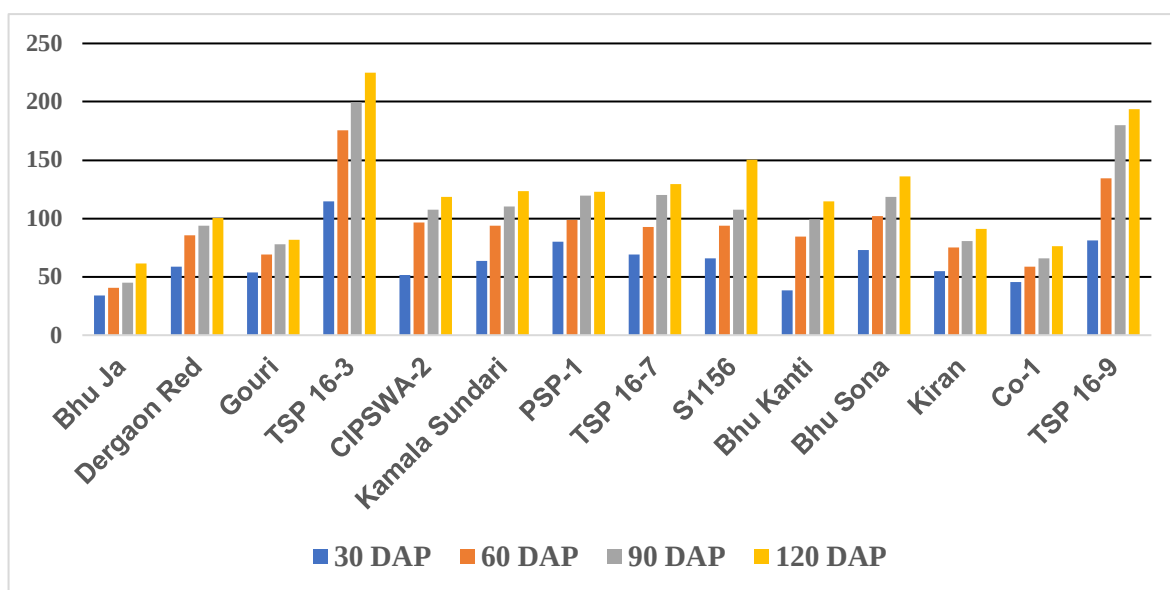


FIG.4.1 MEAN PERFORMANCE OF ORANGE-FLESHED SWEET POTATO GENOTYPES FOR VINE LENGTH (cm)

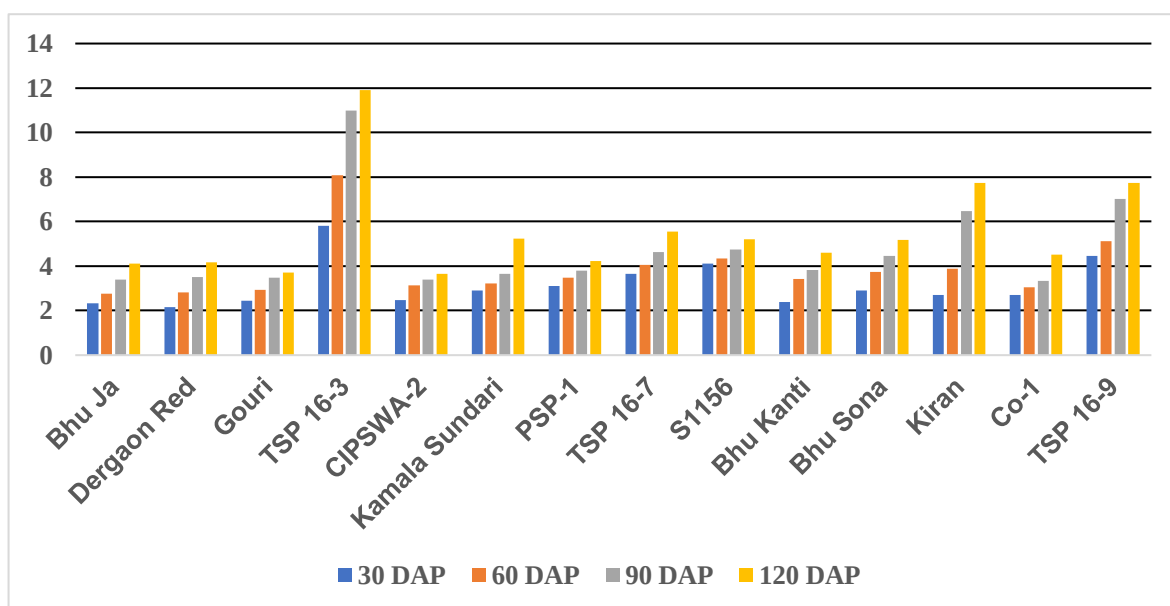


FIG.4.2 MEAN PERFORMANCE OF ORANGE-FLESHED SWEET POTATO GENOTYPES FOR INTERNODAL LENGTH (cm)

Table. 4.2 Mean performance of orange-fleshed sweet potato genotypes for internodal length

S. No.	Name of the genotype	Internodal length (cm)			
		30 days	60 days	90 days	120 days
1	Bhu Ja	2.33	2.75	3.39	4.12
2	Dergaon Red	2.15	2.82	3.52	4.18
3	Gouri	2.45	2.94	3.48	3.71
4	TSP 16-3	5.82	8.07	10.98	11.91
5	CIPSWA-2	2.48	3.13	3.40	3.66
6	Kamala Sundari	2.91	3.22	3.65	5.24
7	PSP-1	3.12	3.48	3.80	4.24
8	TSP 16-7	3.64	4.05	4.62	5.56
9	S1156	4.11	4.34	4.75	5.22
10	Bhu Kanti	2.39	3.43	3.83	4.60
11	Bhu Sona	2.90	3.74	4.46	5.19
12	Kiran	2.70	3.87	6.48	7.75
13	Co-1	2.69	3.06	3.35	4.53
14	TSP 16-9	4.47	5.12	7.03	7.73
Gm		3.15	3.86	4.77	5.54
SEm(±)		0.06	0.09	0.08	0.04
CD at 5%		0.20	0.27	0.27	0.13

4.1.3 Vine weight (g)

The data on vine weight at the time of harvest were presented in Table 4.3. A significant difference ($p \leq 0.05$) was observed in vine weight among different genotypes at the time of harvest. Among all the genotypes, S1156 recorded the maximum vine weight (570.00 g) at the time of harvest, while Gouri recorded the minimum vine weight (146.00 g) at the time of harvest.

4.1.4 Fresh weight of whole plant (g)

The data pertaining to fresh weight of the whole plant were presented in Table 4.4. A significant difference ($p \leq 0.05$) was observed in fresh weight of whole plant among different genotypes of OFSP at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum fresh weight of the whole plant (1537.00 g), while Gouri recorded the minimum fresh weight of the whole plant (403.80 g).

4.1.5 Dry weight of whole plant (g)

The data pertaining to dry weight of whole plant were presented in Table 4.4. A significant difference ($p \leq 0.05$) was observed in dry weight of the whole plant among different genotypes of OFSP at the time of harvest. Among all the genotypes, S1156 recorded the maximum dry weight of whole plant (339.80 g), while Gouri recorded the

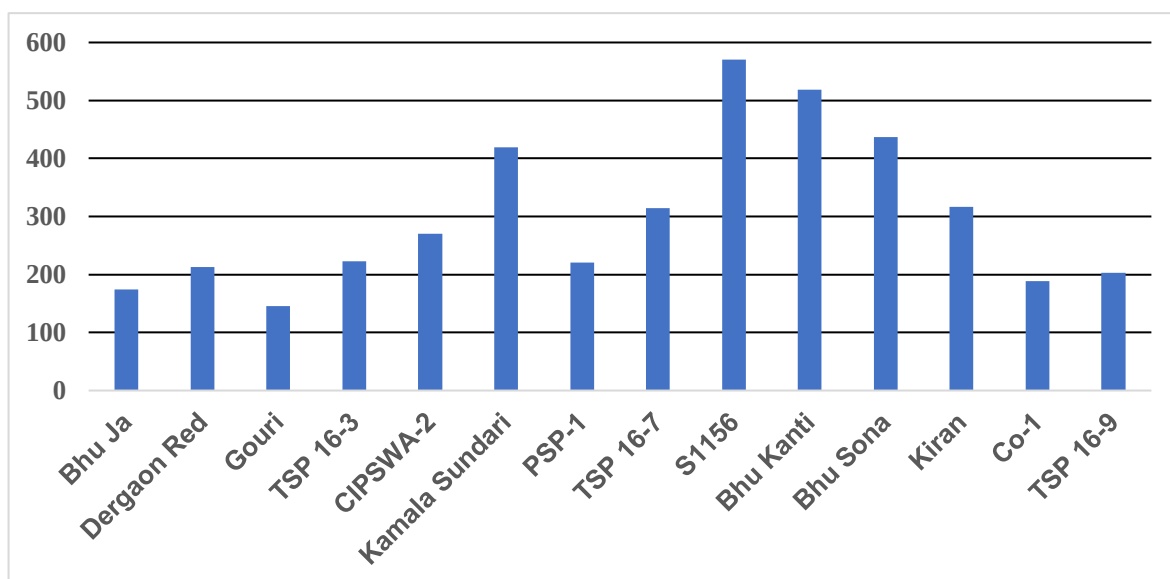


FIG.4.3 MEAN PERFORMANCE OF ORANGE-FLESHED SWEET POTATO GENOTYPES FOR VINE WEIGHT (g) PER PLANT

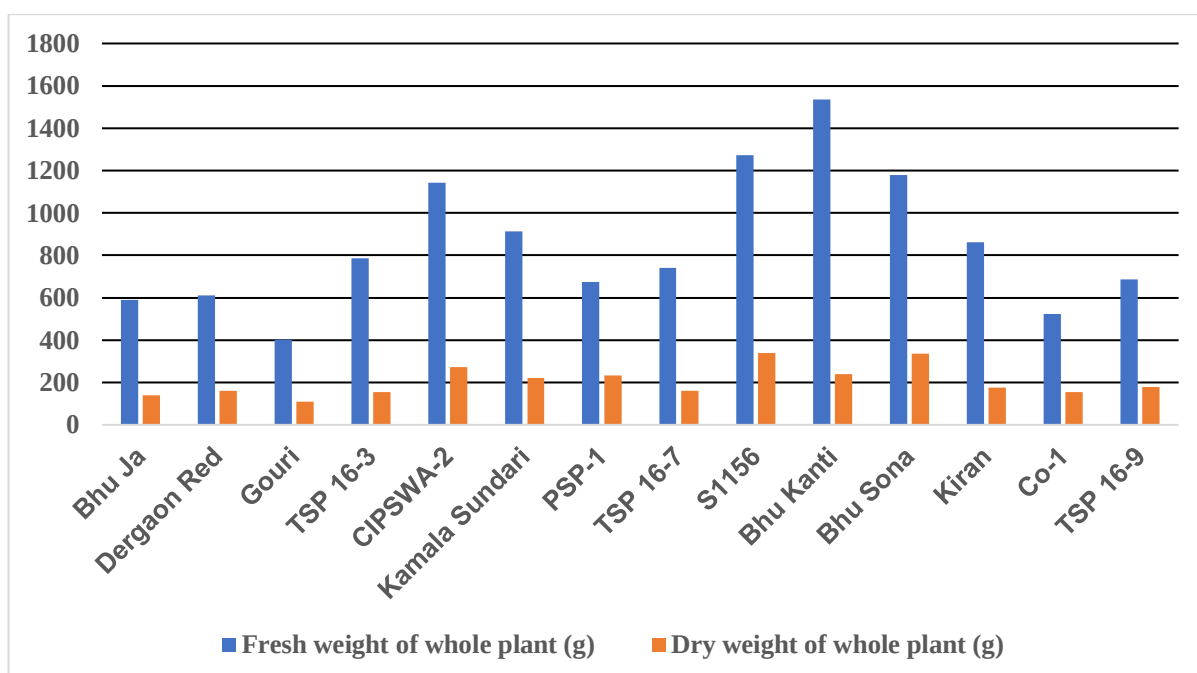


FIG.4.4 MEAN PERFORMANCE OF ORANGE-FLESHED SWEET POTATO GENOTYPES FOR FRESH WEIGHT OF WHOLE PLANT (g) AND DRY WEIGHT OF WHOLE PLANT (g)

minimum dry weight of the whole plant (110.10 g).

Table. 4.3 Mean performance of orange-fleshed sweet potato genotypes for vine weight (g) per plant of fourteen orange fleshed sweet potato genotypes

S.No	Name of the genotype	Vine weight per plant (g)
1	Bhu Ja	173.80
2	Dergaon Red	213.00
3	Gouri	146.00
4	TSP 16-3	222.60
5	CIPSWA-2	270.00
6	Kamala Sundari	418.90
7	PSP-1	221.00
8	TSP 16-7	314.00
9	S1156	570.00
10	Bhu Kanti	518.70
11	Bhu Sona	436.50
12	Kiran	316.50
13	Co-1	188.50
14	TSP 16-9	203.00
Gm		300.89
SEm(±)		26.21
CD at 5%		80.09

Table. 4.4 Mean performance of orange-fleshed sweet potato genotypes for fresh weight of whole plant (g), dry weight of whole plant (g) and plant drymatter content (%)

S.No	Name of the genotype	Fresh weight of whole plant (g)	Dry weight of whole plant (g)	Plant dry matter content (%)
1	Bhu Ja	590.80	140.10	23.76
2	Dergaon Red	610.00	161.80	26.57
3	Gouri	403.80	110.10	27.27
4	TSP 16-3	786.00	155.30	19.76
5	CIPSWA-2	1143.00	272.80	23.90
6	Kamala Sundari	913.00	220.40	24.15
7	PSP-1	674.00	232.10	34.46
8	TSP 16-7	741.00	161.50	21.81
9	S1156	1272.00	339.80	26.72
10	Bhu Kanti	1537.00	239.20	15.58
11	Bhu Sona	1180.20	334.90	28.40
12	Kiran	861.40	176.00	20.44
13	Co-1	523.40	155.00	29.69
14	TSP 16-9	686.00	179.20	26.18
Gm		851.54	205.58	24.90
SEm(±)		26.37	2.74	0.70
CD at 5%		80.58	8.34	2.15

4.1.6 Plant dry matter content (%)

The data pertaining to plant dry matter content were presented in Table 4.4. A significant difference ($p \leq 0.05$) was observed in plant dry matter content among different genotypes of OFSP at the time of harvest. Among all the genotypes, PSP-1 recorded the maximum plant dry matter content (34.46 %), while Bhu Kanti recorded the minimum plant dry matter content (15.58 %).

4.1.7 Fresh weight of tuber (g)

The data pertaining to fresh weight of tuber were presented in Table 4.5. A significant difference ($p \leq 0.05$) was observed in the fresh weight of tuber among different genotypes of OFSP at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum fresh weight of tuber (897.50 g), while Gouri recorded the minimum fresh weight of tuber (251.00 g).

4.1.8 Dry weight of tuber (g)

The data pertaining to dry weight of tuber were presented in Table 4.5. A significant difference ($p \leq 0.05$) was observed in dry weight of tuber among different genotypes of OFSP at the time of harvest. Among all the genotypes, S1156 recorded the maximum dry weight of tuber (225.80 g), while Co-1 recorded the minimum dry weight of tuber (87.60 g).

4.1.9 Tuber dry matter content (%)

The data pertaining to tuber dry matter content were presented in Table 4.5. A significant difference ($p \leq 0.05$) was observed in tuber dry matter content among different genotypes of OFSP at the time of harvest. Among all the genotypes, PSP-1 recorded the maximum tuber dry matter content (38.49 %), while Bhu Kanti recorded the minimum tuber dry matter content (19.31 %).

4.1.10 Tuber moisture content (%)

The data pertaining to tuber moisture content were presented in Table 4.5. A significant difference ($p \leq 0.05$) was observed in tuber moisture content among different genotypes of OFSP at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum tuber moisture content (80.89%), while PSP-1 recorded the minimum tuber moisture content (61.51%).

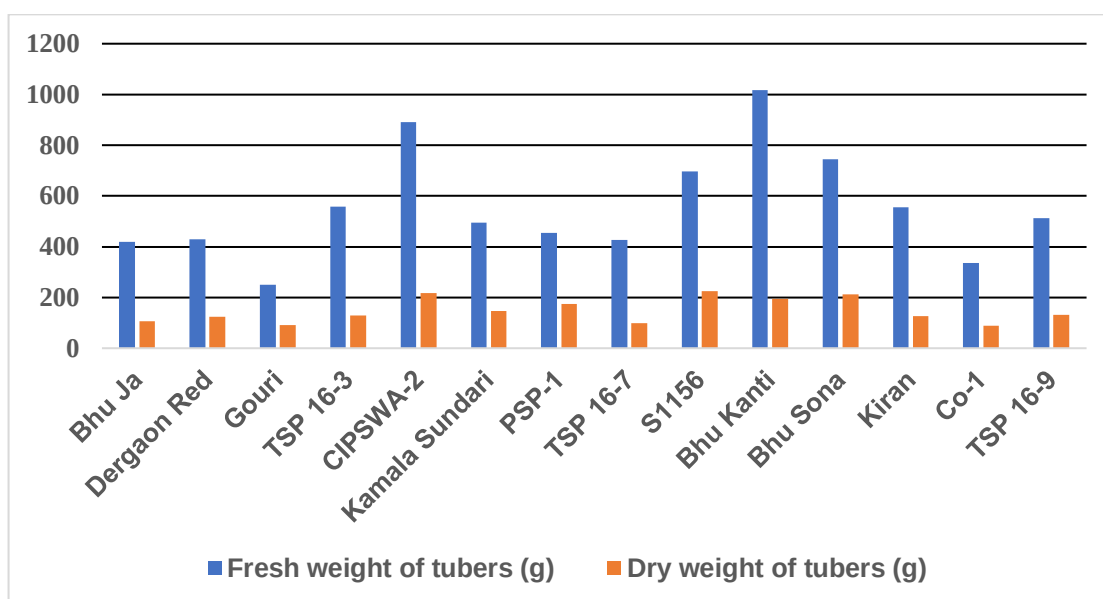


FIG. 4.5 MEAN PERFORMANCE OF ORANGE-FLESHED SWEET POTATO GENOTYPES FOR FRESH WEIGHT OF TUBER (g) AND DRY WEIGHT OF TUBER (g)

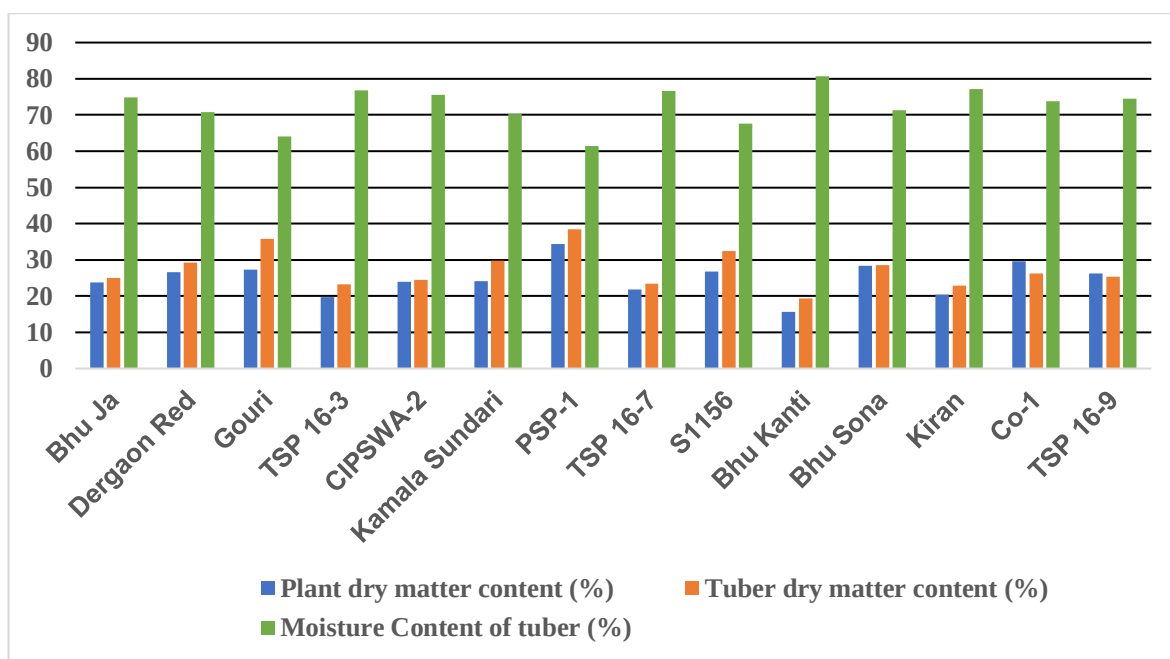


FIG. 4.6 MEAN PERFORMANCE OF ORANGE-FLESHED SWEET POTATO GENOTYPES FOR PLANT DRY MATTER CONTENT (%), TUBER DRY MATTER CONTENT (%) AND MOISTURE CONTENT (%)

Table. 4.5 Mean performance of orange-fleshed sweet potato genotypes for fresh weight of tuber (g), dry weight of tuber (g) and tuber dry matter content of orange fleshed sweet potato genotypes

S.No	Name of the genotype	Fresh weight of tuber (g)	Dry weight of tuber (g)	Tuber dry matter content (%)	Tuber moisture content (%)
1	Bhu Ja	420.10	105.30	25.07	74.93
2	Dergaon Red	428.00	125.10	29.23	70.78
3	Gouri	251.00	90.00	35.86	64.14
4	TSP 16-3	558.50	129.30	23.18	76.82
5	CIPSWA-2	892.00	218.00	24.50	75.50
6	Kamala Sundari	494.00	146.80	29.72	70.29
7	PSP-1	454.00	174.70	38.49	61.51
8	TSP 16-7	427.00	99.60	23.42	76.59
9	S1156	697.00	225.80	32.41	67.59
10	Bhu Kanti	897.50	195.80	19.31	80.89
11	Bhu Sona	745.50	211.50	28.62	71.39
12	Kiran	555.20	126.70	22.83	77.17
13	Co-1	335.20	87.60	26.21	73.80
14	TSP 16-9	513.50	130.40	25.41	74.59
Gm		556.29	147.61	27.44	72.56
SEm(±)		30.55	2.74	1.07	1.07
CD at 5%		93.34	8.38	3.29	3.29

4.1.11 Length of the tuber (cm)

The data pertaining to length of the tuber were presented in Table 4.6. A significant difference ($p \leq 0.05$) was observed in the length of the tuber among different genotypes of OFSP at the time of harvest. Among all the genotypes, Kamala Sundari recorded the maximum length of the tuber (26.66 cm), while PSP-1 recorded the minimum length of the tuber (15.95 cm).

4.1.12 Diameter of tuber (cm)

The data pertaining to diameter of tuber were presented in Table 4.6. A significant difference ($p \leq 0.05$) was observed in the diameter of tuber among different genotypes of OFSP at the time of harvest. Among all the genotypes, CIPSWA-2 recorded the maximum diameter of tuber (6.18 cm), while TSP 16-7 recorded the minimum diameter of tuber (3.13 cm).

4.1.13 Number of tubers per plant

The data pertaining to number of tubers per plant were presented in Table 4.6. A

significant difference ($p \leq 0.05$) was observed in number of tubers among different genotypes

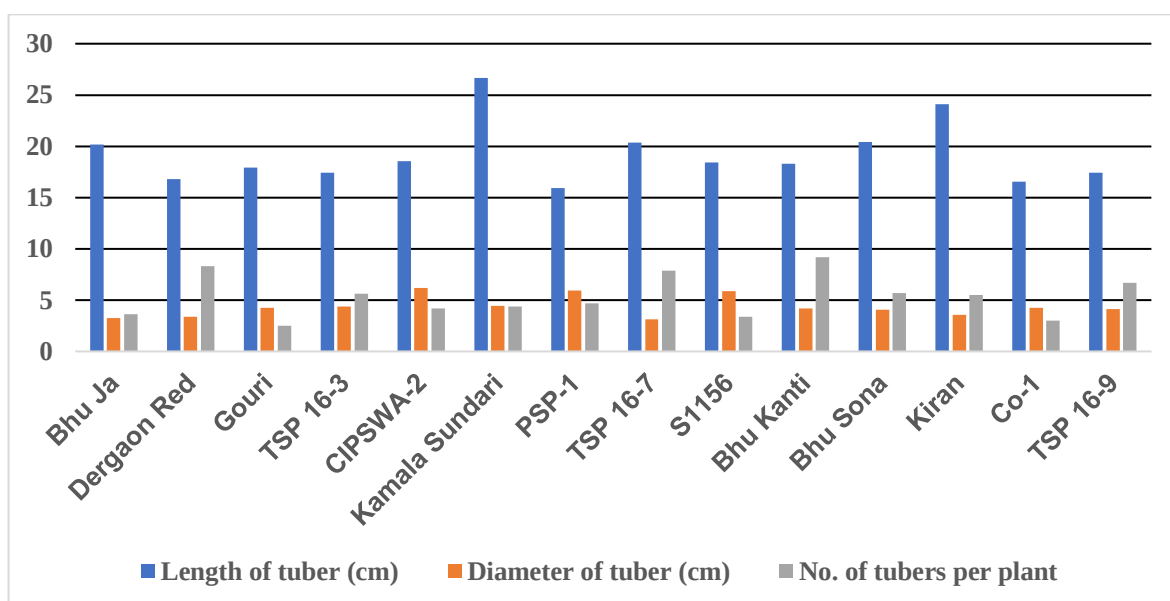


FIG.4.7 MEAN PERFORMANCE OF ORANGE FLESHED SWEET POTATO GENOTYPES FOR LENGTH OF TUBER, DIAMETER OF TUBER, NO.OF TUBERS PER PLANT

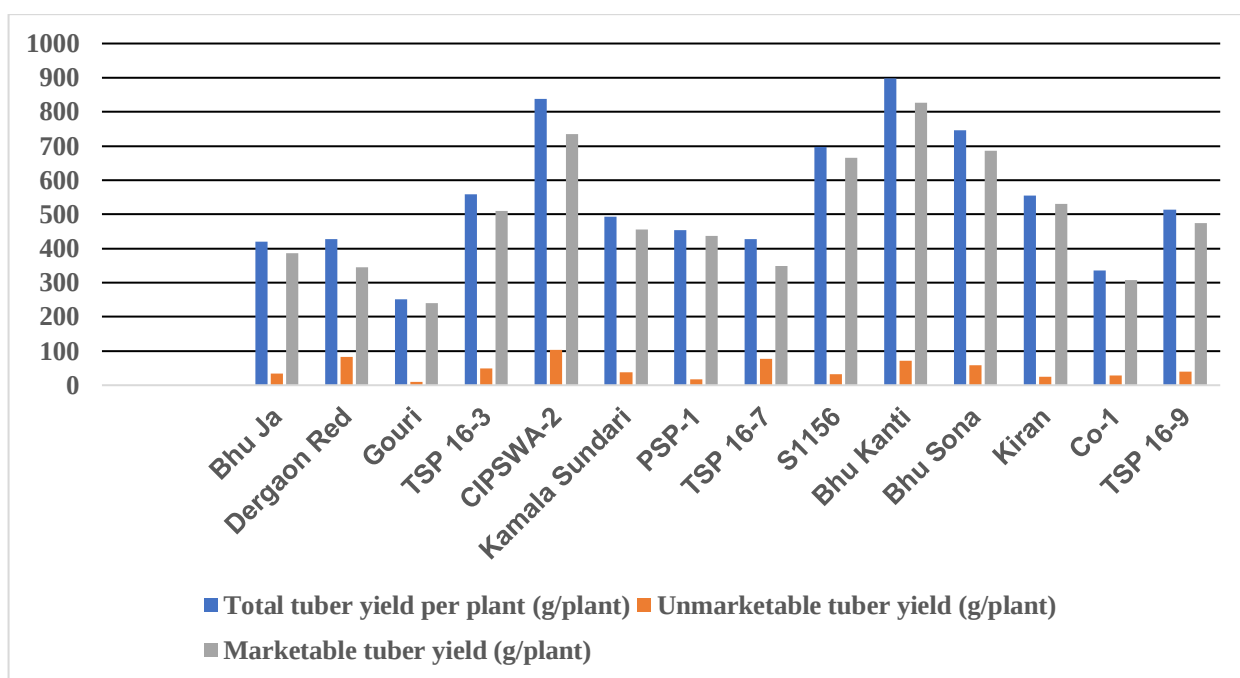


FIG.4.8 MEAN PERFORMANCE OF ORANGE FLESHED SWEET POTATO GENOTYPES FOR VARIOUS YIELD CHARACTERS

of OFSP at harvesting time. Among all the genotypes, Bhu Kanti recorded the maximum number of tubers per plant (9.20), while Gouri recorded the minimum number of tubers per plant (2.50).

4.1.14 Total tuber yield per plant (g)

The data pertaining to total tuber yield per plant were presented in Table 4.6. A significant difference ($p \leq 0.05$) was observed in total tuber yield per plant among different genotypes of OFSP at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum total tuber yield per plant (897.50 g), while Gouri recorded the minimum total tuber yield per plant (251.00 g).

4.1.14 Total tuber yield per hectare (t/ha)

The data pertaining to total tuber yield per hectare were presented in Table 4.6. A significant difference ($p \leq 0.05$) was observed in total tuber yield per hectare among different genotypes of OFSP at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum total tuber yield per hectare (63.50 t/ha), while Gouri recorded the minimum total tuber yield per hectare (17.76 t/ha).

4.1.15 Unmarketable tuber yield per plant (g)

The data pertaining to unmarketable tuber yield per plant were presented in Table 4.6. A significant difference ($p \leq 0.05$) was observed in unmarketable tuber yield per plant among different genotypes of OFSP at the time of harvest. Among all the genotypes, CIPSWA-2 recorded the maximum unmarketable tuber yield per plant (103.00 g), while Gouri recorded the minimum unmarketable tuber yield per plant (10.50 g).

4.1.14 Unmarketable total tuber yield per hectare (t/ha)

The data pertaining to unmarketable tuber yield per hectare were presented in Table 4.6. A significant difference ($p \leq 0.05$) was observed in unmarketable tuber yield per hectare among different genotypes of OFSP at the time of harvest. Among all the genotypes, CIPSWA-2 recorded the maximum unmarketable tuber yield per hectare (7.29 t/ha), while Gouri recorded the minimum unmarketable tuber yield per hectare (0.74 t/ha).

4.1.16 Marketable tuber yield per plant (g)

The data pertaining to marketable tuber yield per plant were presented in Table 4.6. A significant difference ($p \leq 0.05$) was observed in tuber yield per plant among different genotypes of OFSP at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum marketable tuber yield per plant (826.00 g), followed by CIPSWA-2 (734.5

Table. 4.6 Mean performance of orange fleshed sweet potato genotypes for various morphological parameters

S.No.	Name of the genotype	Length of tuber (cm)	Diameter of tuber (cm)	No. of tubers per plant	Total tuber yield per plant (g)	Total tuber yield (t/ha)	Unmarketable tuber yield (g/plant)	Unmarketable tuber yield per hectare (t/ha)	Marketable tuber yield (g/plant)	Marketable tuber yield per hectare (t/ha)
1	Bhu Ja	20.18	3.27	3.60	420.10	29.72	33.90	2.40	386.20	27.32
2	Dergaon Red	16.80	3.38	8.30	428.00	30.28	82.00	5.80	346.00	24.48
3	Gouri	17.90	4.27	2.50	251.00	17.76	10.50	0.74	240.50	17.01
4	TSP 16-3	17.40	4.39	5.60	558.50	39.51	48.50	3.43	510.00	36.08
5	CIPSWA-2	18.52	6.18	4.20	837.50	59.25	103.00	7.29	734.50	51.96
6	Kamala	26.66	4.42	4.40	494.00	34.95	38.00	2.69	456.00	32.26
7	PSP-1	15.95	5.92	4.70	454.00	32.12	17.50	1.24	436.50	30.88
8	TSP 16-7	20.35	3.13	7.90	427.00	30.21	77.50	5.48	349.50	24.73
9	S1156	18.41	5.87	3.40	697.00	49.31	32.00	2.26	665.00	47.05
10	Bhu Kanti	18.30	4.21	9.20	897.50	63.50	71.50	5.06	826.00	58.44
11	Bhu Sona	20.40	4.09	5.70	745.50	52.74	59.00	4.17	686.50	48.57
12	Kiran	24.10	3.55	5.50	555.20	39.28	25.20	1.78	530.00	37.50
13	Co-1	16.55	4.25	3.00	335.20	23.71	27.70	1.96	307.50	21.76
14	TSP 16-9	17.45	4.10	6.70	513.50	36.33	39.00	2.76	474.50	33.57
Gm		19.21	4.35	5.33	543.86	38.48	47.52	3.36	515.22	35.11
SEm(±)		0.46	0.09	0.22	23.18	1.64	NS	NS	31.95	2.13
CD at 5%		1.40	0.28	0.69	70.80	5.01	NS	NS	97.60	6.54

g) and Bhu Sona (686.50 g), while Gouri recorded the minimum marketable tuber yield per plant (240.50 g).

4.1.17 Marketable tuber yield per hectare (t/ha)

The data pertaining to marketable tuber yield per hectare were presented in Table 4.6. A significant difference ($p \leq 0.05$) was observed in marketable tuber yield per hectare among different genotypes of OFSP at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum marketable tuber yield per hectare (58.44 t/ha), followed by CIPSWA-2 (51.96 t/ha), Bhu Sona (48.57 t/ha), while Gouri recorded the minimum marketable tuber yield per hectare (17.01 t/ha).

4.2 QUALITY PARAMETERS

4.2.1 Total Soluble Solids (°Brix)

The data pertaining to total soluble solids were presented in Table 4.7. A significant difference ($p \leq 0.05$) was observed in total soluble solids among different genotypes of OFSP at the time of harvest. Among all the genotypes TSP 16-7 recorded the maximum total soluble solids (12.35 °Brix), while Bhu Kanti recorded the minimum total soluble solids (7.00 °Brix).

4.2.2 Total carotenoids (mg/100g)

The data pertaining to total carotenoids were presented in Table 4.7. A significant difference ($p \leq 0.05$) was observed in total carotenoids among different genotypes of OFSP at the time of harvest. Among all the genotypes, PSP-1 recorded the maximum total carotenoids (14.31 mg/100g), while Dergaon Red recorded the minimum total carotenoids (1.06 mg/100g).

4.2.3 Starch content (%)

The data pertaining to starch content were presented in Table 4.7. A significant difference ($p \leq 0.05$) was observed in starch content among different genotypes of OFSP at the time of harvest. Among all the genotypes, Co-1 recorded the maximum starch content (22.75 %), while TSP 16-9 recorded the minimum starch content (10.15 %).

4.2.4 Total sugars (%)

The data pertaining to total sugars were presented in Table 4.7. A significant difference ($p \leq 0.05$) was observed in total sugars among different genotypes of OFSP at the time of harvest. Among all the genotypes, Co-1 recorded the maximum total sugars (8.82 %), while Kiran recorded the minimum total sugars (3.42 %).

Table.4.7 Mean performance of orange-fleshed sweet potato genotypes for various quality parameters

S. No.	Name of genotype	TSS (°Brix)	Total carotenoids (mg/100g)	Starch content (%)	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)	Shelf life (days)
1	Bhu Ja	7.78	5.37	17.60	4.18	3.74	0.44	20.50
2	Dergaon Red	10.35	1.06	18.00	6.53	6.08	0.46	21.50
3	Gouri	7.85	5.15	16.65	3.45	2.86	0.59	24.50
4	TSP 16-3	8.25	7.41	10.70	4.19	3.50	0.70	17.50
5	CIPSWA-2	7.93	2.76	22.20	3.51	2.83	0.68	27.00
6	Kamala Sundari	8.10	3.55	12.55	7.06	6.36	0.76	31.50
7	PSP-1	10.05	14.31	16.90	4.95	4.19	0.76	28.00
8	TSP 16-7	12.35	6.86	10.28	5.78	5.18	0.60	19.50
9	S1156	7.65	7.11	18.40	3.95	3.36	0.59	25.50
10	Bhu Kanti	7.00	11.07	17.36	4.63	4.06	0.57	20.00
11	Bhu Sona	10.10	11.01	16.65	3.73	3.16	0.57	33.00
12	Kiran	10.20	6.57	10.50	3.42	3.03	0.40	28.00
13	Co-1	9.75	3.46	22.75	8.82	7.79	1.03	29.00
14	TSP 16-9	8.00	11.10	10.15	5.28	4.58	0.70	18.50
Gm		8.95	6.89	15.76	4.96	4.96	4.33	24.57
SEm(±)		0.11	0.05	0.10	0.03	0.03	0.04	0.70
CD at 5%		0.35	0.16	0.33	0.10	0.10	0.11	2.15

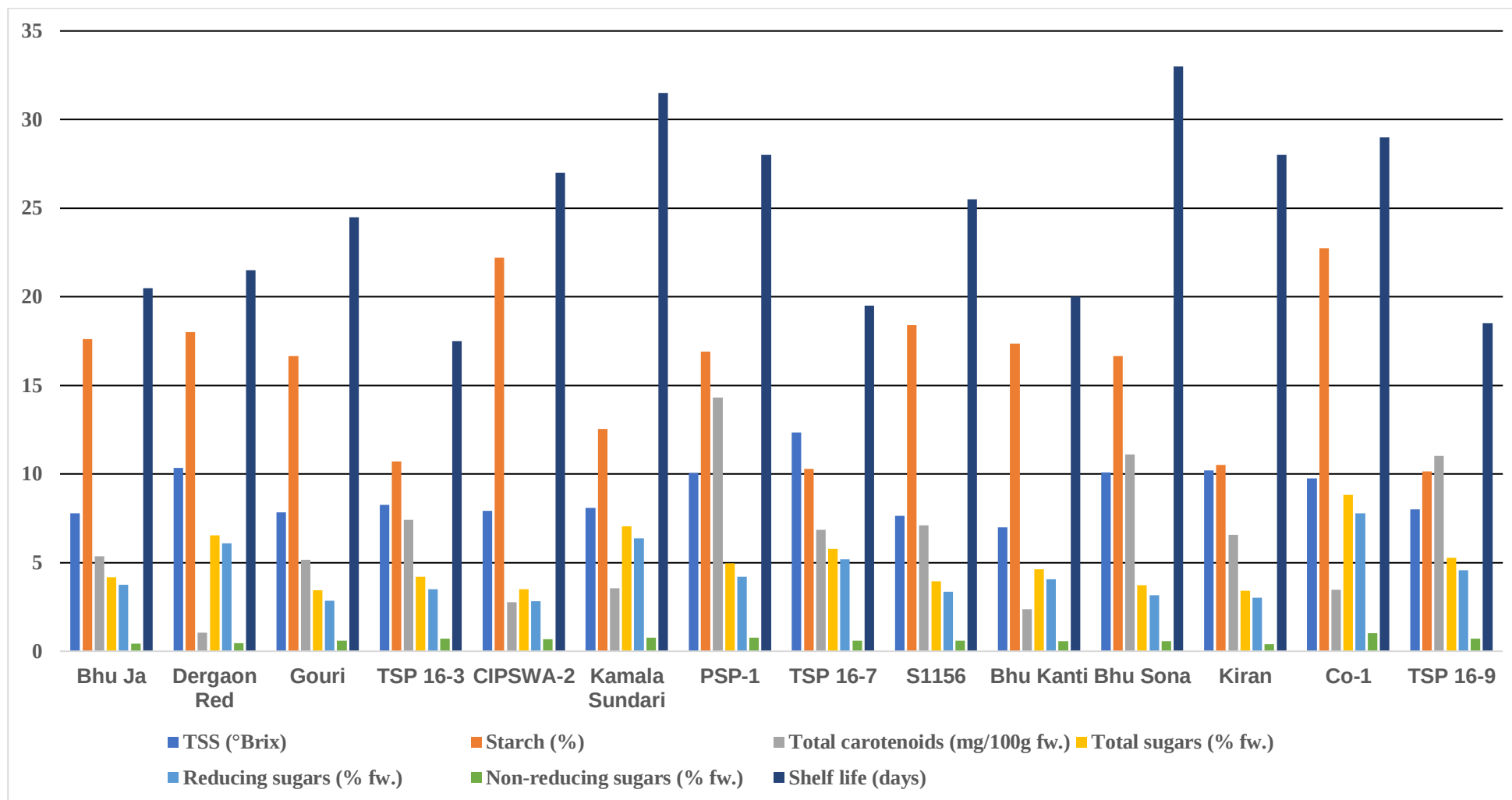


FIG.4.9 MEAN PERFORMANCE OF ORANGE FLESHED SWEET POTATO GENOTYPES FOR VARIOUS QUALITY PARAMETERS

4.2.5 Reducing sugars (%)

The data pertaining to reducing sugars were presented in Table 4.7. A significant difference ($p \leq 0.05$) was observed in reducing sugars among different genotypes at the time of harvest. Among all the genotypes, Co-1 recorded the maximum reducing sugars (7.79 %), while CIPSWA-2 recorded the minimum reducing sugars (2.83 %).

4.2.6 Non-reducing sugars (%)

The data pertaining to non-reducing sugars were presented in Table 4.7. A significant difference ($p \leq 0.05$) was observed in non-reducing sugars among different genotypes, Co-1 recorded the maximum non-reducing sugars (1.03%), while Kiran recorded the minimum non-reducing sugars (0.40%).

4.2.7 Shelf life (days)

The data pertaining to shelf life were presented in Table 4.7. A significant difference ($p \leq 0.05$) was observed in shelf life among different genotypes of OFSP, Bhu Sona recorded the maximum shelf life (33.00 days), while TSP 16-3 recorded the minimum shelf life (17.50 days).

4.3. GENETIC VARIABILITY

The population mean, range, genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV), heritability (broad sense) and expected genetic advance as per cent of mean (GAM) for the characters viz., vine length (cm), inter nodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%), length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, marketable tuber yield per plant (g), marketable tuber yield per hectare (t/ha) and qualitative parameters like total soluble solids ($^{\circ}$ Brix), total carotenoids (mg/100g), starch (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days) were studied and presented in Table 4.8. The PCV was higher than GCV for all the traits under study.

The results obtained on the mean, variability, heritability and genetic advance as per cent of the mean are presented hereunder.

4.3.1 Vine length (cm)

Vine length showed high PCV (37.50 %) and GCV (35.89 %). This trait also recorded high heritability 91.56 per cent with high genetic advance as per cent of the mean (70.74%).

4.3.2 Internodal length (cm)

Internodal length showed high PCV (40.39 %) and GCV (40.30 %). High heritability of 99.58 per cent with high GAM (82.84 %) was recorded for internodal length.

4.3.3 Vine weight per plant (g)

Vine weight per plant showed high PCV (50.33 %) and GCV (43.94 %). High heritability 76.20 per cent along with high GAM (79.01 %) was recorded for vine weight per plant.

4.3.4 Fresh weight of whole plant (g)

The fresh weight of whole plant showed high PCV (37.99 %) and GCV (37.76 %). High heritability of 98.80 per cent with high GAM (77.33%) was recorded for the fresh weight of whole plant.

4.3.5 Dry weight of whole plant (g)

The dry weight of whole plant showed high PCV (34.47 %) and GCV (34.43 %). High heritability of 99.75 per cent with high GAM (70.84 %) was recorded for dry weight of whole plant.

4.3.6 Plant dry matter content (%)

Plant dry matter content showed moderate PCV (19.03 %) and GCV (18.60 %). High heritability of 93.00 per cent with high GAM (48.03%) was recorded for plant dry matter content.

4.3.7 Fresh weight of tuber (g)

The fresh weight of tuber showed high PCV (38.53 %) and GCV (37.92 %). High heritability of 96.83 per cent with high GAM (76.86 %) was recorded for fresh weight of tuber.

4.3.8 Dry weight of tuber (g)

The dry weight of tuber showed high PCV (32.99 %) and GCV (32.92 %). High heritability of 99.57 per cent with high GAM (67.67 %) was recorded for dry weight of tuber.

4.3.9 Tuber dry matter content (%)

Tuber dry matter content showed moderate PCV (19.80 %) and GCV (19.00 %). High heritability of 93.00 per cent with high GAM (48.16%) was recorded for tuber dry matter content.

Table 4.8 Estimates of variability, heritability and genetic advance as per cent of mean for different characters in orange flesh sweet potato genotypes

S.No.	Character	Range		Mean	PCV (%)	GCV (%)	h ² (%)	GA as % of mean
		Minimum	Maximum					
1.	Vine length (cm),	61.30	225.20	123.18	37.50	35.89	91.56	70.74
2.	Internodal length (cm)	3.66	11.91	5.54	40.39	40.30	99.58	82.84
3.	Vine weight per plant (g)	146.00	570.00	300.89	50.33	43.94	76.20	79.01
4.	Fresh weight of whole plant (g)	403.80	1537.00	851.54	37.99	37.76	98.80	77.33
5.	Dry weight of whole plant (g)	110.10	339.80	205.59	34.47	34.43	99.75	70.84
6.	Plant dry matter content (%)	15.57	34.45	24.90	19.03	18.60	93.00	48.03
7.	Fresh weight of tuber (g)	251.00	1017.00	556.29	38.53	37.92	96.83	76.86
8.	Dry weight of tuber (g)	87.60	225.80	147.61	32.99	32.92	99.57	67.67
9.	Tuber dry matter content (%)	19.31	38.49	27.44	19.80	19.00	93.00	48.16
10.	Length of the tuber (cm)	15.95	26.66	19.21	15.65	15.40	96.86	31.23
11.	Diameter of tuber (cm)	3.13	6.18	4.36	23.08	22.42	94.40	44.87
12.	Number of tubers per plant	2.50	9.20	5.34	38.45	38.39	99.69	78.96
13.	Marketable tuber yield per plant (g)	240.50	826.00	496.33	34.70	34.56	99.17	70.90
14.	Marketable tuber yield per hectare	17.01	58.43	35.11	34.70	34.56	99.17	70.90
15.	Total Soluble Solids (°Brix)	7.00	12.35	8.95	17.00	16.77	97.39	34.10
16.	Total carotenoids (mg/100g)	1.06	14.31	6.29	59.96	59.96	100.00	123.51
17.	Starch content (%)	10.15	22.75	15.76	27.06	27.04	99.86	55.66
18.	Total sugars (%)	3.423	7.064	4.960	32.22	32.20	99.85	66.28
19.	Reducing sugars (%)	2.825	7.790	4.580	34.80	34.74	99.68	71.46
20.	Non-reducing sugar (%)	0.398	1.025	0.629	25.20	25.19	99.93	51.87
21.	Shelf life (days)	17.50	33.00	24.57	22.26	20.25	82.81	37.97

Where: δ^2g = variance due genotypic, δ^2ph = variance due to phenotypic, GCV (%) = genotypic coefficient of variation, PCV (%) = phenotypic coefficient of variation, (h²)b = broad heritability, GAM (%) = Genetic Advance as Per cent of Mean

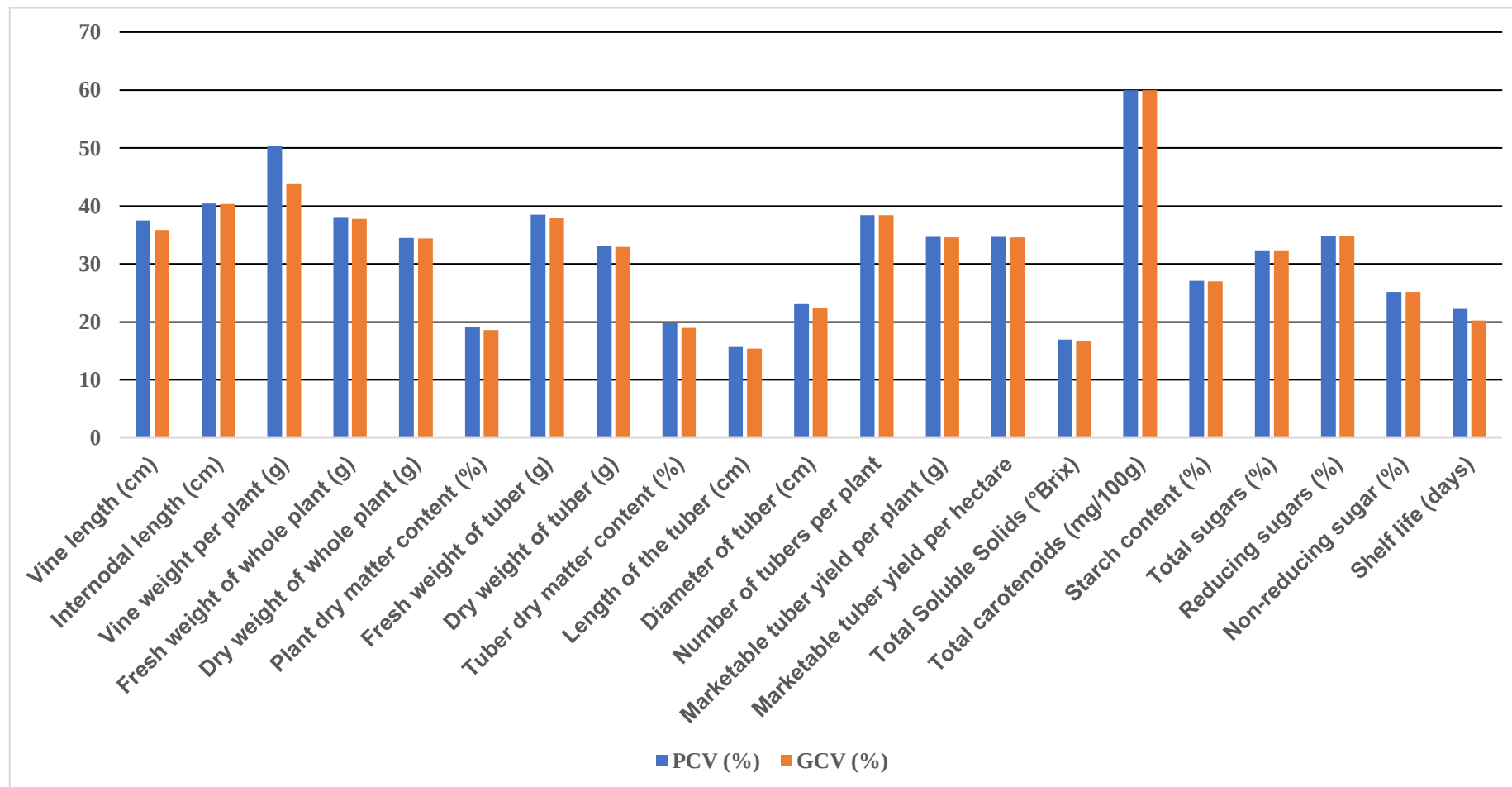


FIG.4.10 PHENOTYPIC AND GENOTYPIC COEFFICIENT OF VARIATION (%) FOR DIFFERENT CHARACTERS OF ORANGE FLESHED SWEET POTATO GENOTYPES

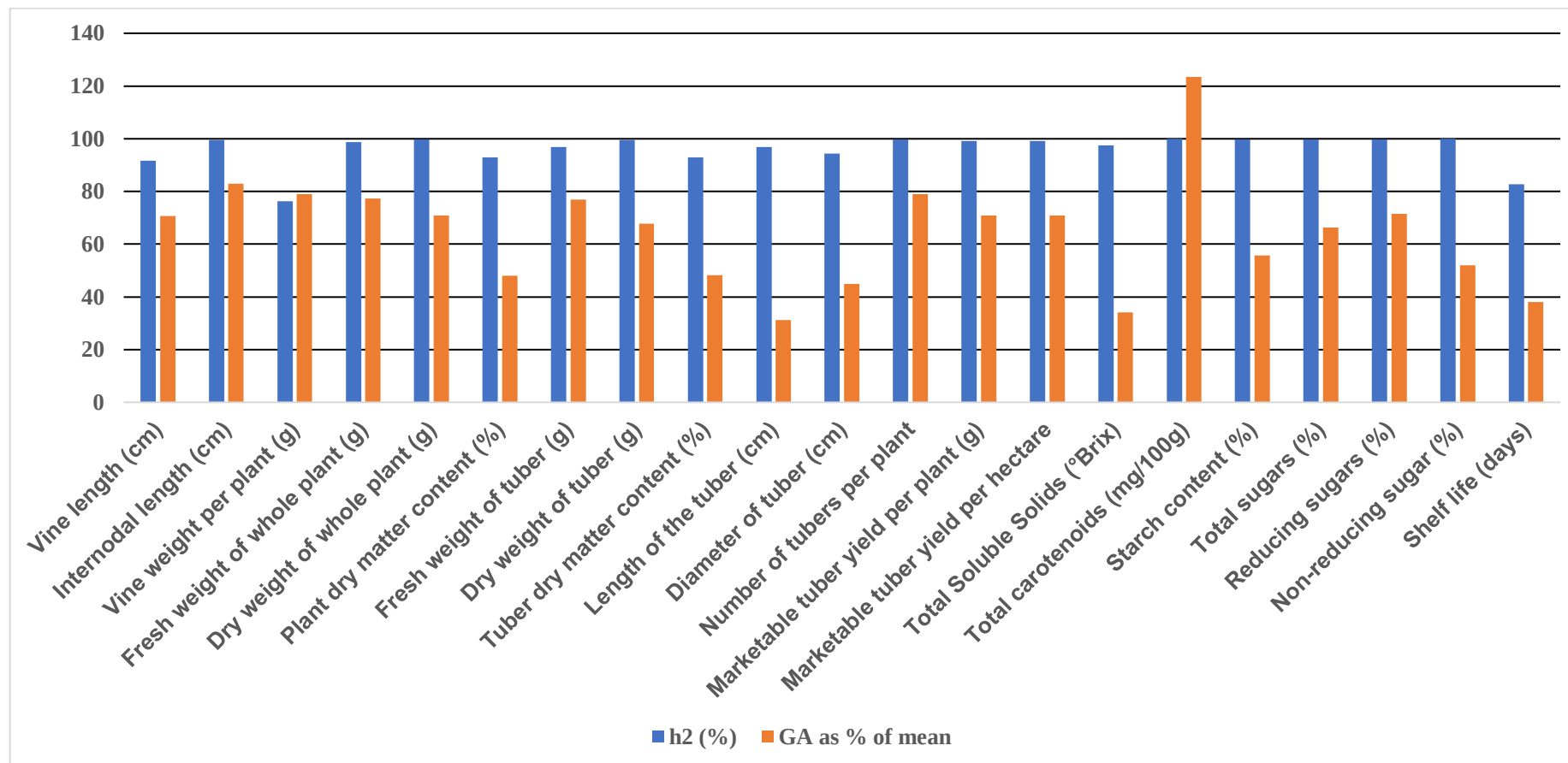


FIG.4.11 HERITABILITY AND GENETIC ADVANCE AS PER CENT OF MEAN IN DIFFERENT CHARACTERS OF ORANGE FLESHED SWEET POTATO GENOTYPES

4.3.10 Length of the tuber (cm)

Length of the tuber showed moderate PCV (15.65 %) and GCV (15.40 %). High heritability of 96.86 per cent with high GAM (31.23%) was recorded for length of the tuber.

4.3.11 Diameter of tuber (cm)

The diameter of tuber showed high PCV (23.08 %) and GCV (22.42 %). High heritability of 94.40 per cent with high GAM (44.87%) was recorded for the diameter of tuber.

4.3.12 Number of tubers per plant

The number of tubers per plant showed high PCV (38.45 %) and GCV (38.39 %). High heritability of 99.69 per cent with high GAM (78.96 %) was recorded for a number of tubers per plant.

4.3.13 Marketable tuber yield per plant (g)

Marketable tuber yield per plant showed high PCV (34.70 %) and GCV (34.56 %). High heritability of 99.17 per cent with high GAM (70.90 %) was recorded for marketable tuber yield per plant.

4.3.14 Marketable tuber yield per hectare (t/ha)

Marketable tuber yield per hectare showed high PCV (34.70 %) and GCV (34.56 %). High heritability of 99.17 per cent with high GAM (70.90 %) was recorded for marketable tuber yield per hectare.

4.3.15 Total soluble solids (°Brix)

Total soluble solids showed moderate PCV (17.00 %) and GCV (16.77 %). High heritability of 97.39 per cent with high GAM (34.10 %) was recorded for total soluble solids.

4.3.16 Total carotenoids (mg/100g)

Total carotenoids showed high PCV (59.96 %) and GCV (59.96 %). High heritability of 100.00 per cent with high GAM (123.51 %) was recorded for total soluble solids.

4.3.17 Starch content (%)

Starch content showed high PCV and GCV of (27.06 %) and (27.04 %), respectively. High heritability 99.86 per cent with high GAM (55.66 %) was recorded for starch content.

4.3.18 Total sugars (%)

Total sugars showed high PCV (32.22 %) and GCV (32.20 %). High heritability of 99.85 per cent with high GAM (66.28 %) was recorded for total sugars.

4.3.19 Reducing sugars (%)

Reducing sugars showed high PCV (34.80 %) and GCV (34.74 %). This trait recorded high heritability of 99.68 per cent and high genetic advance as a per cent of the mean (71.46 %).

4.3.20 Non-reducing sugars (%)

This trait showed high estimates of PCV (25.20 %) and GCV (25.19 %). This trait recorded high heritability of 99.93 per cent and high genetic advance as a per cent of mean (51.87 %).

4.3.21 Shelf life (days)

Shelf life showed high PCV (22.26 %) and GCV (20.25 %). This trait recorded high heritability of 82.81 per cent and high genetic advance as a percent of the mean (37.97 %).

In the present study, wide variability was recorded in respect of vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), fresh weight of tuber (g), dry weight of tuber (g), diameter of tuber (cm), number of tubers per plant, marketable tuber yield per plant (g), marketable tuber yield per hectare (t/ha) and quality parameters viz., total carotenoids (mg/100g), starch (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days) indicating the existence of more variability for these traits in the genotypes under study as they have high PCV and high GCV. Moderate variability was recorded for plant dry matter content (%), tuber dry matter content (%), length of the tuber (cm) and total soluble solids (°Brix). High heritability coupled with high genetic advance as per cent of mean indicates the preponderance of additive gene action in the inheritance of the traits viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%), length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, marketable tuber yield per plant (g), marketable tuber yield per hectare (t/ha) and quality parameters such as the total soluble solids (°Brix), total carotenoids (mg/100g), starch content (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days).

4.4 CORRELATION COEFFICIENT ANALYSIS

The phenotypic (r_p) and genotypic correlation (r_g) coefficients were worked out for thirteen quantitative characters viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%),

length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, marketable tuber yield per plant (g) and two characters viz., total carotenoids (mg/100g) and starch content (%) indicates the presence of sufficient amount of variability in all the characters under study. The results obtained are presented under the following headings (Table 4.9).

4.4.1 Vine length (cm)

Vine length exhibited a significant positive correlation with internodal length ($0.753r_p$, $0.762r_g$) at both 5% and 1% LOS (Level of Significance) and with total carotenoids ($0.426 r_p$, $0.430 r_g$) at 5% LOS and also recorded significant negative correlation with starch content ($-0.510 r_p$, $-0.518 r_g$) at both 5% and 1% LOS.

4.4.2 Internodal length (cm)

Internodal length was significantly and negatively correlated with starch content ($-0.693 r_p$, $-0.694 r_g$) at both 5% and 1% LOS and with plant dry matter ($-0.385 r_p$, $-0.394 r_g$) and tuber dry matter ($-0.375 r_p$, $-0.388 r_g$) at 5% LOS only.

4.4.3 Vine weight per plant (g)

Vine weight per plant exhibited a significant positive correlation with the fresh weight of whole plant ($0.868 r_p$, $0.902 r_g$), dry weight of whole plant ($0.764 r_p$, $0.795 r_g$), fresh weight of tuber ($0.651 r_p$, $0.729 r_g$), dry weight of tuber ($0.700 r_p$, $0.730 r_g$) and marketable tuber yield per plant ($0.682 r_p$, $0.785 r_g$) at both 5% and 1% LOS.

4.4.4 Fresh weight of whole plant (g)

The fresh weight of whole plant exhibited a significant positive correlation with the dry weight of whole plant ($0.796 r_p$, $0.799 r_g$), fresh weight of tuber ($0.940 r_p$, $0.954 r_g$), marketable tuber yield per plant ($0.944 r_p$, $0.967 r_g$), dry weight of tuber ($0.849 r_p$, $0.853 r_g$) at both 5% and 1% LOS. This character also recorded a significant negative correlation with plant dry matter content ($-0.452 r_p$, $-0.445 r_g$) at 5% LOS only.

4.4.5 Dry weight of whole plant (g)

This trait exhibited a significant positive correlation with the dry weight of tuber ($0.942 r_p$, $0.942 r_g$), diameter of tuber ($0.593 r_p$, $0.600 r_g$), fresh weight of tuber ($0.704 r_p$, $0.717 r_g$) and marketable tuber yield per plant ($0.771 r_p$, $0.792 r_g$) at both 5% and 1% LOS.

Table. 4.9 Phenotypic and genotypic correlation coefficients for Morphological characters of orange fleshed sweet potato genotypes

Character		Vine length (cm)	Inter nodal length (cm)	Vine weight per plant (g)	Fresh weight of whole plant (g)	Dry weight of whole plant (g)	Plant dry matter content (%)	Fresh weight of tuber (g)	Dry weight of tuber (g)	Tuber dry matter content (%)	Length of the tuber (cm)	Diameter of tuber (cm)	Number of tubers per plant	Total carotenoids (mg/100g)	Starch (%)
Vine length (cm)	rp	1.000													
	rg	1.000													
Inter nodal length (cm)	rp	0.753**	1.000												
	rg	0.762**	1.000												
Vine weight per plant (g)	rp	0.178	-0.050	1.000											
	rg	0.173	-0.050	1.000											
Fresh weight of whole plant (g)	rp	0.243	-0.015	0.868**	1.000										
	rg	0.238	-0.016	0.902**	1.000										
Dry weight of whole plant (g)	rp	0.240	-0.171	0.764**	0.796**	1.000									
	rg	0.239	-0.171	0.795**	0.799**	1.000									
Plant dry matter content (%)	rp	-0.159	-0.385*	-0.315	-0.452*	0.133	1.000								
	rg	-0.157	-0.394*	-0.325	-0.445*	0.138	1.000								
Fresh weight of tuber (g)	rp	0.255	0.007	0.651**	0.940**	0.704**	-0.472**	1.000							
	rg	0.260	0.006	0.729**	0.954**	0.717**	-0.475**	1.000							
Dry weight of tuber (g)	rp	0.280	-0.145	0.700**	0.849**	0.942**	0.001	0.827**	1.000						
	rg	0.277	-0.146	0.730**	0.853**	0.942**	0.003	0.843**	1.000						
Tuber dry matter content (%)	rp	-0.125	-0.375*	-0.119	-0.351	0.120	0.812**	-0.464*	0.064	1.000					
	rg	-0.143	-0.388*	-0.186	-0.360	0.122	0.840**	-0.441*	0.063	1.000					
Length of the tuber (cm)	rp	-0.151	0.073	0.365	0.196	0.088	-0.353	0.050	-0.006	-0.189	1.000				
	rg	-0.171	0.075	0.360	0.184	0.085	-0.350	0.050	-0.013	-0.221	1.000				
Diameter of tuber (m)	rp	0.229	-0.166	0.237	0.354	0.593**	0.364	0.374*	0.678**	0.431*	-0.264	1.000			
	rg	0.233	-0.168	0.238	0.358	0.600**	0.373*	0.389*	0.687**	0.444*	-0.288	1.000			
Number of tubers per plant	rp	0.275	0.184	0.247	0.337	0.007	-0.486**	0.374*	0.088	-0.496**	-0.041	-0.406*	1.000		
	rg	0.275	0.189	0.246	0.340	0.010	-0.498**	0.386*	0.092	-0.527**	-0.052	-0.419*	1.000		
Total carotenoids (mg/100g)	rp	0.426*	0.278	-0.048	-0.089	0.244	0.476*	-0.109	0.168	0.387*	-0.158	0.225	-0.092	1.000	
	rg	0.430*	0.278	-0.051	-0.089	0.244	0.486**	-0.111	0.169	0.402*	-0.160	0.227	-0.093	1.000	
Starch (%)	rp	-0.510**	-0.693**	0.004	0.116	0.275	0.367	0.175	0.292	0.219	-0.422*	0.440*	-0.373*	-0.363	1.000
	rg	-0.518**	-0.694**	-0.010	0.117	0.276	0.375*	0.182	0.294	0.224	-0.433*	0.445*	-0.379*	-0.365	1.000
Marketable Tuber yield per plant (g)	rp	0.301	0.067	0.682**	0.944**	0.771**	-0.406**	0.980**	0.868**	-0.394*	0.088	0.486**	0.276	0.008	0.134
	rg	0.311	0.067	0.785**	0.967**	0.792**	-0.407**	0.985**	0.892**	-0.364	0.097	0.490**	0.297	0.009	0.142

Note- *5% level of significance, **1% level of significance.

4.4.6 Plant dry matter content (%)

Plant dry matter content exhibited a significant positive correlation with tuber dry matter content (0.812 r_p , 0.840 r_g) and total carotenoids (0.476 r_p , 0.486 r_g) at both 5% and 1% LOS and with at 5% LOS, respectively.

This character also recorded a significant negative correlation with fresh weight of tuber (-0.472 r_p , -0.475 r_g) at 5% LOS, number of tubers per plant (-0.486 r_p , -0.498 r_g) at both 5% and 1% LOS and with marketable tuber yield per plant (-0.406 r_p , -0.407 r_g) at 5% LOS only.

4.4.7 Fresh weight of tuber (g)

Fresh weight of tuber exhibited a significant positive correlation with dry weight of tuber (0.827 r_p , 0.843 r_g) and marketable tuber yield per plant (0.980 r_p , 0.985 r_g) at both 5% and 1% LOS and with a diameter of tuber (0.374 r_p , 0.389 r_g) and number of tubers per plant (0.374 r_p , 0.386 r_g) at 5% LOS. This character also recorded a significant negative correlation with tuber dry matter content (-0.464 r_p , -0.441 r_g) at 5% LOS only.

4.4.8 Dry weight of tuber (g)

The dry weight of tuber exhibited a significant positive correlation with the diameter of tuber (0.678 r_p , 0.687 r_g) and marketable tuber yield per plant (0.868 r_p , 0.892 r_g) at both 5% and 1% LOS.

4.4.9 Tuber dry matter content (%)

Tuber dry matter content exhibited a significant positive correlation with the diameter of tuber (0.431 r_p , 0.444 r_g) and total carotenoids (0.387 r_p , 0.402 r_g) at 5% LOS.

This character also recorded a significant negative correlation with the number of tubers per plant (-0.496 r_p , -0.527 r_g) at both 5% and 1% LOS.

4.4.10 Length of the tuber (cm)

Length of the tuber recorded significant negative correlation with starch content (-0.422 r_p , -0.433 r_g) respectively at 5% LOS.

4.4.11 Diameter of tuber (cm)

The diameter of tuber exhibited a positive significant correlation with starch content (0.440 r_p , 0.445 r_g) at 5% LOS and marketable tuber yield per plant (0.486 r_p , 0.490 r_g) at both 5% and 1% LOS. This trait also recorded a significant negative correlation with the number of tubers per plant (-0.406 r_p , -0.419 r_g) at 5% LOS.

4.4.12 Number of tubers per plant

The number of tubers per plant showed non-significant association with starch content at both genotypic and phenotypic levels (-0.373 r_p , -0.379 r_g) at 5% LOS only.

4.4.13 Total carotenoids (mg/100g)

Total carotenoids showed non-significant association with starch content and marketable tuber yield per plant at both phenotypic and genotypic levels.

4.4.14 Starch content (%)

Starch content showed no correlation with marketable tuber yield per plant at both genotypic and phenotypic levels.

4.4.15 Marketable tuber yield per plant (g)

Marketable tuber yield per plant exhibited a positive significant correlation with vine weight per plant (0.682 r_p , 0.785 r_g), fresh weight of plant (0.944 r_p , 0.967 r_g), dry weight of plant (0.771 r_p , 0.792 r_g), fresh weight of tuber (0.980 r_p , 0.985 r_g), dry weight of tuber (0.868 r_p , 0.892 r_g) and diameter of tuber (0.486 r_p , 0.490 r_g) at both 5% and 1% LOS. This trait also showed a significant negative correlation with plant dry matter content (-0.406 r_p , -0.407 r_g) and tuber dry matter content (-0.394 r_p) at 5% LOS.

4.5 PATH COEFFICIENT ANALYSIS

The path coefficient analysis was computed and direct and indirect effects of for quantitative characters viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%), length of the tuber (cm), diameter of tuber (cm), number of tubers per plant and qualitative characters viz., total carotenoids (mg/100g) and starch content (%) on marketable tuber yield per plant were presented in the Table 4.10 are presented under the following headings.

4.5.1 DIRECT EFFECTS

4.5.1.1 Vine length (cm)

Vine length showed a low negative direct effect on marketable tuber yield per plant at the phenotypic level (-0.111 P) and negligible positive direct effect at the genotypic level (0.038 G).

4.5.1.2 Internodal length (cm)

Internodal length showed a low positive direct effect on marketable tuber yield per plant at the phenotypic level (0.105 P) and negligible positive direct effect at the genotypic level (0.026 G).

4.5.1.3 Vine weight per plant (g)

Vine weight per plant showed high negative direct effect on marketable tuber yield per plant at both phenotypic and genotypic levels (-0.439 P, -0.627 G).

4.5.1.4 Fresh weight of whole plant (g)

The fresh weight of whole plant showed a very high positive direct effect on marketable tuber yield per plant at both phenotypic and genotypic levels (1.345 P, 3.220 G).

4.5.1.5 Dry weight of whole plant (g)

The dry weight of whole plant showed a very high negative direct effect on marketable tuber yield per plant at the genotypic level (-2.058 G) and a low negative direct effect (-0.274 P) at the phenotypic level.

4.5.1.6 Plant dry matter content (%)

Plant dry matter content showed a high positive direct effect on marketable tuber yield per plant at both phenotypic and genotypic levels (0.341 P, 0.920 G).

4.5.1.7 Fresh weight of tuber (g)

The fresh weight of tuber showed a very high negative direct effect on marketable tuber yield per plant at the genotypic level (-2.031 G) and negligible positive effect at the phenotypic level (0.083 P).

4.5.1.8 Dry weight of tuber (g)

The dry weight of tuber showed a very high positive direct effect on tuber yield per plant at the genotypic level (2.657 G) and a high positive direct effect at the phenotypic level (0.472 P).

4.5.1.9 Tuber dry matter content (%)

Tuber dry matter content showed high negative direct effect on marketable tuber yield per plant at the genotypic level (-0.832 G) and a low negative direct effect at the phenotypic level (-0.160 P).

4.5.1.10 Length of the tuber (cm)

The length of the tuber showed a negligible negative direct effect on marketable tuber yield per plant (-0.091 P, -0.031 G) at both phenotypic and genotypic levels.

4.5.1.11 Diameter of tuber (cm)

The diameter of tuber showed a high positive direct effect on marketable tuber yield per plant (0.310 P, 0.325 G) at both phenotypic and genotypic levels.

4.5.1.12 Number of tubers per plant

The number of tubers per plant showed a high negative direct effect on marketable tuber yield per plant at the genotypic level (-0.320 G) and a moderate negative direct effect at the phenotypic level (-0.201 P).

Table. 4.10 Phenotypic and genotypic path coefficient analysis of Morphological characters of orange fleshed sweet potato genotypes

Character		Vine length (cm)	Inter nodal length (cm)	Vine weight per plant (g)	Fresh weight of whole plant (g)	Dry weight of whole plant (g)	Plant dry matter content (%)	Fresh weight of tuber (g)	Dry weight of tuber (g)	Tuber dry matter content (%)	Length of the tuber (cm)	Diameter of tuber (cm)	Number of tubers per plant	Total carotenoids (mg/100g)	Starch (%)
Vine length (cm)	Rp	<u>-0.111</u>	-0.083	-0.020	-0.027	-0.027	0.018	-0.028	-0.031	0.014	0.017	-0.050	-0.030	-0.047	0.057
	Rg	<u>0.038</u>	0.029	0.007	0.009	0.009	-0.006	0.010	0.011	-0.006	-0.007	0.014	0.011	0.017	-0.020
Internodal length (cm)	Rp	0.079	<u>0.105</u>	-0.005	-0.002	-0.018	-0.041	0.001	-0.015	-0.039	0.008	0.001	0.019	0.029	-0.073
	Rg	0.020	<u>0.026</u>	-0.001	0.000	-0.004	-0.010	0.000	-0.004	-0.010	0.002	0.002	0.005	0.007	-0.018
Vine weight per plant (g)	Rp	-0.078	0.022	<u>-0.439</u>	-0.381	-0.335	0.138	-0.286	-0.307	0.052	-0.160	-0.138	-0.108	0.021	0.002
	Rg	-0.109	0.031	<u>-0.627</u>	-0.566	-0.499	0.204	-0.458	-0.458	0.117	-0.226	-0.195	-0.154	0.032	0.006
Fresh weight of whole plant (g)	Rp	0.327	-0.021	1.167	<u>1.345</u>	1.070	-0.608	1.264	1.141	-0.472	0.264	0.335	0.454	-0.120	0.156
	Rg	0.768	-0.050	2.905	<u>3.220</u>	2.574	-1.434	3.070	2.745	-1.158	0.592	0.548	1.094	-0.288	0.376
Dry weight of whole plant (g)	Rp	-0.066	0.047	-0.209	-0.218	<u>-0.274</u>	-0.037	-0.193	-0.258	-0.033	-0.024	-0.195	-0.002	-0.067	-0.075
	Rg	-0.491	0.352	-1.636	-1.645	<u>-2.058</u>	-0.283	-1.475	-1.938	-0.251	-0.175	-0.211	-0.020	-0.502	-0.568
Plant dry matter content (%)	Rp	-0.054	-0.131	-0.108	-0.154	0.045	<u>0.341</u>	-0.161	0.000	0.277	-0.120	0.078	-0.166	0.162	0.125
	rg	-0.144	-0.363	-0.299	-0.410	0.127	<u>0.920</u>	-0.437	0.003	0.773	-0.322	0.024	-0.458	0.447	0.345
Fresh weight of tuber (g)	rp	0.021	0.001	0.054	0.078	0.058	-0.039	<u>0.083</u>	0.068	-0.038	0.004	0.165	0.031	-0.009	0.015
	rg	-0.529	-0.011	-1.481	-1.937	-1.456	0.965	<u>-2.031</u>	-1.713	0.897	-0.102	-0.194	-0.784	0.225	-0.370
Dry weight of tuber (g)	rp	0.132	-0.068	0.330	0.400	0.444	0.001	0.390	<u>0.472</u>	0.030	-0.003	0.115	0.041	0.079	0.138
	rg	0.737	-0.387	1.940	2.266	2.503	0.008	2.241	<u>2.657</u>	0.168	-0.036	0.283	0.245	0.448	0.781
Tuber dry matter content (%)	rp	0.020	0.060	0.019	0.056	-0.019	-0.130	0.074	-0.010	<u>-0.160</u>	0.030	-0.100	0.079	-0.062	-0.035
	rg	0.119	0.323	0.155	0.299	-0.102	-0.699	0.367	-0.053	<u>-0.832</u>	0.184	-0.090	0.439	-0.334	-0.186
Length of the tuber (cm)	rp	0.014	-0.007	-0.033	-0.018	-0.008	0.032	-0.005	0.001	0.017	<u>-0.091</u>	0.010	0.004	0.014	0.039
	rg	0.005	-0.002	-0.011	-0.006	-0.003	0.011	-0.002	0.000	0.007	<u>-0.031</u>	-0.096	0.002	0.005	0.014
Diameter of tuber (cm)	rp	-0.029	0.021	-0.030	-0.045	-0.075	-0.046	-0.047	-0.085	-0.054	0.033	<u>0.310</u>	0.051	-0.028	-0.055
	rg	-0.089	0.064	-0.091	-0.137	-0.230	-0.143	-0.149	-0.263	-0.170	0.110	<u>0.325</u>	0.160	-0.087	-0.170
Number of tubers per plant	rp	-0.055	-0.037	-0.050	-0.068	-0.001	0.098	-0.075	-0.018	0.100	0.008	0.052	<u>-0.201</u>	0.018	0.075
	rg	-0.088	-0.060	-0.079	-0.109	-0.003	0.159	-0.123	-0.029	0.169	0.017	-0.03	<u>-0.320</u>	0.030	0.121
Total carotenoids (mg/100g)	rp	-0.034	-0.022	0.004	0.007	-0.019	-0.037	0.009	-0.013	-0.030	0.012	-0.040	0.007	<u>-0.079</u>	0.029
	rg	-0.025	-0.016	0.003	0.005	-0.014	-0.029	0.007	-0.010	-0.024	0.009	0.023	0.005	<u>-0.059</u>	0.021
Starch (%)	rp	0.133	0.181	0.001	-0.030	-0.072	-0.096	-0.046	-0.076	-0.057	0.110	-0.080	0.098	0.095	<u>-0.261</u>
	rg	0.098	0.132	0.002	-0.022	-0.052	-0.071	-0.035	-0.056	-0.042	0.082	0.071	0.072	0.069	<u>-0.190</u>
Marketable Tuber yield per plant (g)	rp	0.301	0.067	0.682	0.944	0.771	-0.406	0.980	0.868	-0.394	0.088	0.486	0.276	0.009	<u>0.134</u>
	rg	0.311	0.067	0.785	0.967	0.792	-0.407	0.985	0.892	-0.364	0.097	0.490	0.297	0.009	<u>0.142</u>

Phenotypic Residual effect = **0.0667**; Genotypic Residual effect= **0.0230**; Diagonal (under lined) values indicate direct effects.

4.5.1.13 Total carotenoids (mg/100g)

Total carotenoids showed negligible negative direct effects on marketable tuber yield per plant at both phenotypic and genotypic levels (-0.079 P, -0.059 G).

4.5.1.14 Starch content (%)

Starch content showed a moderate negative direct effect on marketable tuber yield per plant at phenotypic (-0.261 P) and a low negative direct effect at the genotypic level (-0.190 G).

4.5.2 INDIRECT EFFECTS

4.5.2.1 Vine length (cm)

Vine length exhibited high positive indirect effect on marketable tuber yield through fresh weight of whole plant (0.327 P, 0.768 G) at both phenotypic and genotypic levels followed by dry weight of the tuber (0.737 G) at genotypic level and low positive indirect effect on marketable tuber yield through dry weight of tuber (0.132 P) at phenotypic level, tuber dry matter content (0.119 G) at genotypic level and negligible positive effect through inter nodal length (0.079 P, 0.020 G) followed by length of the tuber (0.014 P, 0.005 G) at both phenotypic and genotypic levels and through fresh weight of the tuber (0.021 P) and starch content (0.133 P) at the phenotypic level.

This trait also showed a high negative indirect effect on marketable tuber yield through dry weight of the whole plant (-0.491 G) followed by fresh weight of tuber (-0.529 G) at the genotypic level and low negative indirect effect on tuber yield through vine weight per plant (-0.109 G) followed by plant dry matter content (-0.144 G) at the genotypic level. This trait also exhibited a negligible negative indirect effect on tuber yield through vine weight per plant (-0.078 P) followed by dry weight of whole plant (-0.066 P), plant dry matter content (-0.054 P) at phenotypic level and diameter of tuber (-0.029 P, -0.089 G), number of tubers per plant (-0.055 P, -0.088 G) and total carotenoids (-0.034 P, -0.025 G) at both phenotypic and genotypic levels.

4.5.2.2 Internodal length (cm)

Internodal length exhibited a high positive indirect effect on marketable tuber yield (i) through dry weight of whole plant (0.352 G) and tuber dry matter content (0.323 G) at the genotypic level, (ii) low positive indirect effect on marketable tuber yield through starch content (0.181 P, 0.132 G) at both phenotypic and genotypic levels (iii) negligible positive indirect effect on marketable tuber yield through vine weight per plant (0.022 P, 0.031 G)

and diameter of tuber (0.021 P, 0.064 G) at both phenotypic and genotypic levels, (iv) through dry weight of the whole plant (0.047 P) followed by fresh weight of the tuber (0.001 P), tuber dry matter content (0.060 P) at the phenotypic level and (v) through vine length (0.029 G) at genotypic level.

This trait showed a high negative indirect effect on marketable tuber yield through plant dry matter content (-0.363 G) and dry weight of the tuber (-0.387 G) at the genotypic level and exhibited a low negative indirect effect on marketable tuber yield through plant dry matter content (-0.131 P) at the phenotypic level. This trait also showed negligible negative indirect effect on marketable tuber yield through fresh weight of the whole plant (-0.021 P, -0.050 G) followed by length of the tuber (-0.007 P, -0.002 G), number of tubers per plant (-0.037 P, -0.060 G) and total carotenoids (-0.022 P, -0.016 G) at both phenotypic and genotypic levels, through vine length (-0.083 P) and dry weight of the tuber (-0.068 P) at phenotypic level and through fresh weight of tuber (-0.011 G) at genotypic level.

4.5.2.3 Vine weight per plant (g)

This trait showed a very high positive indirect effect on marketable tuber yield through fresh weight of whole plant (1.167 P, 2.905 G) at both phenotypic and genotypic levels and dry weight of tuber (1.940 G) and high positive indirect effect (0.330 P) at genotypic and phenotypic levels respectively. This trait also exhibited a low positive indirect effect on marketable tuber yield through tuber dry matter content at the genotypic level (0.155 G).

This trait also exhibited a negligible positive indirect effect on marketable tuber yield through total carotenoids (0.004 P, 0.003 G) and starch content (0.001 P, 0.002 G) at both phenotypic and genotypic levels and fresh weight of tuber (0.054 P), tuber dry matter content (0.019 P) at the phenotypic level and vine length (0.007 G) at the genotypic level.

This trait also showed a very high negative indirect effect on marketable tuber yield through the dry weight of the whole plant (-1.636 G) and fresh weight of tuber (-1.481 G) and a moderate negative indirect effect on marketable tuber yield through dry weight of the whole plant (-0.209 P) and plant dry matter content (-0.299 G) at phenotypic and genotypic levels respectively. This trait also showed low negative indirect effect on marketable tuber yield through plant dry matter content (-0.108 P) at phenotypic level and negligible negative indirect effect on marketable tuber yield through inter nodal length (-0.005 P, -0.001 G), length of the tuber (-0.033 P, -0.011 G), diameter of tuber (-0.030 P, -0.091 G) and number of tubers per plant (-0.050 P, -0.079 G) at both phenotypic and genotypic levels and vine length (-0.020 P) at phenotypic level.

4.5.2.4 Fresh weight of whole plant (g)

This trait exhibited very high and high positive indirect effects on marketable tuber yield through the dry weight of tuber (2.266 G) and (0.400 P) at phenotypic and genotypic levels respectively and moderate effect through tuber dry matter content (0.299 G) genotypic level. This trait also exhibited negligible positive indirect effect on marketable tuber yield through vine length (0.009 G) followed by internodal length (0.000 G) at genotypic level, fresh weight of tuber (0.078 P), tuber dry matter content (0.056 P) at phenotypic level and total carotenoids (0.007 P, 0.005 G) at both phenotypic and genotypic levels.

This trait also exhibited a very high negative indirect effect on marketable tuber yield through dry weight of whole plant (-1.645 G), fresh weight of tuber (-1.937 G) at genotypic level and high effect through vine weight per plant (-0.381 P, -0.566 G) at both phenotypic and genotypic levels, plant dry matter content (-0.410 G) at the genotypic level and moderate indirect effect through dry weight of whole plant (-0.218 P), low indirect effect through diameter of tuber (-0.137 G) followed by plant dry matter content (-0.154 P) and number of tubers per plant (-0.109 G). This trait also exhibited negligible negative effect through vine length (-0.027 P) followed by internodal length (-0.002 P), diameter of tuber (-0.045 P), number of tubers per plant (-0.068 P) at phenotypic level and length of the tuber (-0.018 P, -0.006 G) and starch content (-0.030 P, -0.022 G) at both phenotypic and genotypic levels.

4.5.2.5 Dry weight of whole plant (g)

The dry weight of whole plant exhibited very high positive indirect effect on marketable tuber yield through fresh weight of whole plant (1.070 P, 2.574 G) at both phenotypic and genotypic levels and dry weight of tuber (2.503 G) at genotypic level, high indirect effect through dry weight of tuber (0.444 P) at phenotypic level and low indirect effect through plant dry matter content (0.127 G) at genotypic level. This trait also exhibited a negligible positive indirect effect on marketable tuber yield through plant dry matter content (0.045 P), fresh weight of tuber (0.058 P) at the phenotypic level and vine length (0.009 G) at the phenotypic level.

This trait exhibited very high negative indirect effect on marketable tuber yield through fresh weight of tuber (-1.456 G) at genotypic level, high negative indirect effect through vine weight per plant (-0.335 P, -0.499 G) at both phenotypic and genotypic levels and moderate negative indirect effect through diameter of tuber (-0.230 G) at genotypic level, low negative indirect effect through tuber dry matter content (-0.102 G) at genotypic level. This trait also exhibited negligible negative indirect effect on tuber yield through internodal length (-0.018 P, -0.004 G), length of the tuber (-0.008 P, -0.003 G), number of

tubers per plant (-0.001 P, -0.003 G), total carotenoids (-0.019 P, -0.014 G) and starch content (-0.072 P, -0.052 G) at both phenotypic and genotypic levels and also vine length (-0.027 P), tuber dry matter content (-0.019 P) and diameter of tuber (-0.075 P) at phenotypic level.

4.5.2.6 Plant dry matter content (%)

Plant dry matter content exhibited a high positive indirect effect on marketable tuber yield through fresh weight of tuber (0.965 G) at genotypic level, moderate positive indirect effect through vine weight per plant (0.204 G) at genotypic level and low vine weight per plant (0.138 P) at phenotypic level, number of tubers per plant (0.159 G) at genotypic level. This trait also exhibited a negligible positive indirect effect on marketable tuber yield through the dry weight of tuber (0.001 P, 0.008 G) and length of the tuber (0.032 P, 0.011 G) at both phenotypic and genotypic levels followed by the number of tubers per plant (0.098 P) and vine length (0.018 P) at the phenotypic level.

This trait exhibited a very high negative indirect effect on marketable tuber yield through fresh weight of whole plant (-1.434 G) at genotypic level and high negative indirect effect through fresh weight of whole plant (-0.608 P) at phenotypic level, tuber dry matter content (-0.699 G) at genotypic level, moderate negative indirect effect through dry weight of whole plant (-0.283 G) at genotypic level and also exhibited low negative indirect effect through tuber dry matter content (-0.130 P) at phenotypic level and diameter of tuber (-0.143 G) at the genotypic level. This trait also exhibited negligible negative indirect effect through internodal length (-0.041 P -0.010 G), total carotenoids (-0.037 P, -0.029 G), and starch content (-0.096 P, -0.071 G) at both phenotypic and genotypic levels, dry weight of whole plant (-0.037 P), fresh weight of tuber (-0.039 P), diameter of tuber (-0.046 P) at phenotypic level and vine length (-0.006 G) at genotypic level.

4.5.2.7 Fresh weight of tuber (g)

Fresh weight of tuber exhibited a very high positive indirect effect on marketable tuber yield through fresh weight of whole plant (1.264 P, 3.070 G) at both phenotypic and genotypic levels, dry weight of tuber (2.241 G) at genotypic level and high positive indirect effect through dry weight of tuber (0.390 P) at phenotypic level, tuber dry matter content (0.367 G) at genotypic level. This trait also exhibited negligible positive indirect effect on marketable tuber yield through internodal length (0.001 P, 0.000 G) and total carotenoids (0.009 P, 0.007 G) at both phenotypic and genotypic levels, vine length (0.010 G) at genotypic level and tuber dry matter content (0.074 P) at phenotypic level.

This trait also exhibited high negative indirect effect on marketable tuber yield through dry weight of whole plant (-1.475 G) at genotypic level and high negative indirect effect through vine weight per plant (-0.458 G), plant dry matter content (-0.437 G) at genotypic level and moderate negative indirect effect through vine weight per plant (-0.286 P) at phenotypic level, low negative indirect effect through dry weight of whole plant (-0.193 P), plant dry matter content (-0.161 P), diameter of tuber (-0.149 G) and number of tubers per plant (-0.123 G) at genotypic level. This trait also exhibited negligible negative indirect effect on marketable tuber yield through length of the tuber (-0.005 P, -0.002 G) and starch content (-0.046 P, -0.035 G) at both phenotypic and genotypic levels, vine length (-0.028 P), diameter of tuber (-0.047 P) and number of tubers per plant (-0.075 P) at the phenotypic level.

4.5.2.8 Dry weight of tuber (g)

The dry weight of tuber exhibited a very high positive indirect effect on marketable tuber yield through the fresh weight of the whole plant (1.141 P, 2.745 G) at both phenotypic and genotypic levels and also exhibited a negligible positive indirect effect on marketable tuber yield through plant dry matter content (0.000 P, 0.003 G), length of the tuber (0.001 P, 0.000 G) at both phenotypic and genotypic levels, vine length (0.011 G) at the genotypic level and fresh weight of tuber (0.068 P) at the phenotypic level.

This trait also exhibited a very high negative indirect effect on marketable tuber yield through dry weight of whole plant (-1.938 G), fresh weight of tuber (-1.713 G) at genotypic level, and high negative indirect effect on marketable tuber yield through vine weight per plant (-0.307 P, -0.458 G) at both phenotypic and genotypic levels and also a moderate negative indirect effect on marketable tuber yield through dry weight of whole plant (-0.258 P) at the phenotypic level, diameter of tuber (-0.263 G) at the genotypic level. This trait also exhibited negligible negative indirect effect on marketable tuber yield through internodal length (-0.015 P, -0.004 G) at both phenotypic and genotypic levels, tuber dry matter content (-0.010 P, -0.053 G), number of tubers per plant (-0.018 P, -0.029 G), total carotenoids (-0.013 P, -0.010 G), starch content (-0.076 P, -0.056 G) at both phenotypic and genotypic levels and vine length (-0.031 P), diameter of tuber (-0.085 P) at phenotypic level.

4.5.2.9 Tuber dry matter content (%)

Tuber dry matter content exhibited a high positive indirect effect on marketable tuber yield through plant dry matter content (0.773 G), fresh weight of tuber (0.897 G) at a genotypic level, moderate positive indirect effect through plant dry matter content (0.277 P), low positive indirect effect through dry weight of tuber (0.168 G), vine weight per plant

(0.117 G) at genotypic level, number of tubers per plant (0.100 P, 0.169 G) at both phenotypic and genotypic levels, negligible positive indirect effect through vine length (0.014 P), vine weight per plant (0.052 P), dry weight of tuber (0.030 P) at phenotypic level, length of the tuber (0.017 P, 0.007 G) at both phenotypic and genotypic levels.

This trait also exhibited very high negative indirect effect on marketable tuber yield through fresh weight of whole plant (-1.158 G) at genotypic level and high negative indirect effect on tuber yield through fresh weight of whole plant (-0.472 P) at phenotypic level and also showed moderate negative indirect effect on marketable tuber yield through dry weight of whole plant (-0.251 G) at genotypic level, low negative indirect effect on tuber yield through diameter of tuber (-0.170 G) at genotypic level and negligible negative indirect effect through internodal length (-0.039 P) followed by dry weight of whole plant (-0.033 P), fresh weight of tuber (-0.038 P) and diameter of tuber (-0.054 P) at phenotypic level, vine length (-0.006 G), internodal length (-0.010 G) at genotypic level, total carotenoids (-0.030 P, -0.024 G) and starch content (-0.057 P, -0.042 G) at both phenotypic and genotypic levels.

4.5.2.10 Length of the tuber (cm)

Length of the tuber exhibited high positive indirect effect on marketable tuber yield through fresh weight of whole plant (0.592 G) at genotypic level and moderate positive indirect effect through fresh weight of whole plant (0.264 P) at phenotypic level and low positive indirect effect through tuber dry matter content (0.184 G), diameter of tuber (0.110 G) at genotypic level and starch content (0.110 P) at phenotypic level. This trait also exhibited negligible positive indirect effect on marketable tuber yield through vine length (0.017 P) followed by tuber dry matter content (0.030 P), fresh weight of tuber (0.004 P), diameter of tuber (0.033 P) at the phenotypic level and starch content (0.082 G) at the genotypic level and internodal length (0.008 P, 0.002 G), number of tubers per plant (0.008 P, 0.017 G) and total carotenoids (0.012 P, 0.009 G) at both phenotypic and genotypic levels.

Length of the tuber also recorded a high negative indirect effect on marketable tuber yield through plant dry matter content (-0.322 G) and a moderate negative indirect effect through vine weight per plant (-0.226 G), low negative indirect effect through vine weight per plant (-0.160 P) and plant dry matter content (-0.120 P) at the phenotypic level, dry weight of whole plant (-0.175 G) and fresh weight of tuber (-0.102 G) at the genotypic level and also showed negligible negative indirect effect on marketable tuber yield through vine length (-0.007 G) at genotypic level, dry weight of whole plant (-0.024 P) at phenotypic level and dry weight of tuber (-0.003 P, -0.036 G) at both phenotypic and genotypic levels.

4.5.2.11 Diameter of tuber (cm)

The diameter of tuber exhibited a high positive indirect effect on marketable tuber yield through fresh weight of the whole plant (0.335 P, 0.548 G) at both genotypic and phenotypic levels and moderate positive indirect effect through dry weight of tuber (0.283 G) at genotypic level and low positive indirect effect through fresh weight of tuber (0.165 P), dry weight of tuber (0.115 P) at phenotypic level. This trait also showed negligible positive indirect effect through number of tubers per plant (0.052 P), length of the tuber (0.010 P) at phenotypic level and vine length (0.014 G), total carotenoids (0.023 G) and starch content (0.071 G) at genotypic level, internodal length (0.001 P, 0.002 G) and plant dry matter content (0.078 P, 0.024 G) at both phenotypic and genotypic levels.

This trait also exhibited a moderate negative indirect effect on marketable tuber yield through dry weight of whole plant (-0.211 G) at the genotypic level and low negative indirect effect through dry weight of whole plant (-0.195 P) and tuber dry matter content (-0.100 P) at phenotypic level, fresh weight of tuber (-0.194 G) at genotypic level and vine weight per plant (-0.138 P, -0.195 G) at both phenotypic and genotypic levels. This trait also showed a negligible negative indirect effect on tuber yield through vine length (-0.050 P), total carotenoids (-0.040 P) and starch content (-0.080 P) at the phenotypic level, tuber dry matter content (-0.090 G), length of the tuber (-0.096 G) and number of tubers per plant (-0.030 G) at the genotypic level.

4.5.2.12 Number of tubers per plant

The number of tubers per plant exhibited a very high positive indirect effect on marketable tuber yield through fresh weight of the whole plant (1.094 G) at the genotypic level and a high positive indirect effect through the fresh weight of the whole plant (0.454 P) at the phenotypic level, tuber dry matter content (0.439 G) at a genotypic level, moderate-high positive indirect effect through dry weight of tuber (0.245 G) at the genotypic level and also exhibited low high positive indirect effect through the diameter of tuber (0.160 G) at the genotypic level. This trait also showed negligible positive indirect effect through dry weight of tuber (0.041 P) followed by fresh weight of tuber (0.031 P), tuber dry matter content (0.079 P), diameter of tuber (0.051 P) at the phenotypic level, and vine length (0.011 G) at genotypic level, internodal length (0.019 P, 0.005 G), length of the tuber (0.004 P, 0.002 G), total carotenoids (0.007 P, 0.005 G) and starch content (0.098 P, 0.072 G) at both phenotypic and genotypic levels.

This trait also exhibited high negative indirect effect on marketable tuber yield through fresh weight of tuber (-0.784 G) and plant dry matter content (-0.458 G) at genotypic

level and low negative indirect effect on tuber yield through plant dry matter content (-0.166 P) at phenotypic level, vine weight per plant (-0.108 P, -0.154 G) at both phenotypic and genotypic levels and also exhibited negligible negative indirect effect on marketable tuber yield through vine length (-0.030 P) at phenotypic level and dry weight of whole plant (-0.002 P, -0.020 G) at both phenotypic and genotypic levels.

4.5.2.13 Total carotenoids (mg/100g)

Total carotenoids exhibited a high positive indirect effect on marketable tuber yield through plant dry matter content (0.447 G), dry weight of tuber (0.448 G) at the genotypic level, and a moderate positive indirect effect through the fresh weight of tuber (0.225 G) at the genotypic level and a low positive indirect effect through plant dry matter content (0.162 P) at the phenotypic level. This trait also exhibited negligible positive indirect effect through dry weight of tuber (0.079 P) at the phenotypic level, vine length (0.017 G) at the genotypic level, and vine weight per plant (0.021 P, 0.032 G), internodal length (0.029 P, 0.007 G), length of the tuber (0.014 P, 0.005 G), number of tubers per plant (0.018 P, 0.030 G) and starch content (0.095 P, 0.069 G) at both phenotypic and genotypic levels.

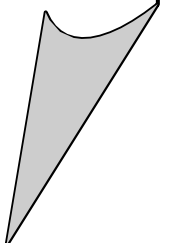
This trait also exhibited a high negative indirect effect on marketable tuber yield through dry weight of whole plant (-0.502 G), tuber dry matter content (-0.334 G) at genotypic level, moderate negative indirect effect through fresh weight of whole plant (-0.288 G) at genotypic level, low negative indirect effect through fresh weight of whole plant (-0.120 P) and also exhibited negligible negative indirect effects through vine length (-0.047 P), dry weight of whole plant (-0.067 P), fresh weight of tuber (-0.009 P) and tuber dry matter content (-0.062 P) at phenotypic level and diameter of tuber (-0.028 P, -0.087 G) at both phenotypic and genotypic levels.

4.5.2.14 Starch content (%)

Starch content exhibited a high positive indirect effect on marketable tuber yield through dry weight of tuber (0.781 G), fresh weight of whole plant (0.376 G) and plant dry matter content (0.345 G) at the genotypic level, a low positive indirect effect through fresh weight of whole plant (0.156 P), plant dry matter content (0.125 P), dry weight of tuber (0.138 P) at the phenotypic level and number of tubers per plant (0.121 G) at the genotypic level and a negligible positive indirect effect through vine length (0.057 P), fresh weight of tuber (0.015 P) and number of tubers per plant (0.075 P) at the phenotypic level and via vine weight per plant (0.002 P, 0.006 G), length of the tuber (0.039 P, 0.014 G) and total carotenoids (0.029 P, 0.021G) at both phenotypic and genotypic levels.

This trait also exhibited a high negative indirect effect on marketable tuber yield via dry weight of the whole plant (-0.568 G) and fresh weight of tuber (-0.370 G) at the genotypic level and low negative indirect effect through tuber dry matter content (-0.186 G) and diameter of tuber (-0.170 G) at genotypic level and also exhibited negligible indirect effects through vine length (-0.020 G) at genotypic level and dry weight of whole plant (-0.075 P), tuber dry matter content (-0.035 P), diameter of tuber (-0.055 P) at the phenotypic level and internodal length (-0.073 P, -0.018 G) at both phenotypic and genotypic levels.

Discussion... 



CHAPTER V

DISCUSSION

Sweet potato is one of the important popular tuber crops grown throughout India. While reviewing the breeding aspects of sweet potato, it was observed that very less systematic work has been made to improve this crop for developing new varieties with desirable characters like high yield, vigour with less spreading, high percentage of 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 magnitude of genetic variability can determine the pace and quantum of genetic improvement through selection or hybridization followed by selection.

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 at the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during rabi, 2022-2023.

The implications of the experimental results of the investigation are discussed under the following sub heads:

5.1 Morphological characters

5.2 Quality characters

5.3 Variability and related parameters

5.4 Correlation coefficient analysis

5.5 Path coefficient analysis

5. 1 MORPHOLOGICAL CHARACTERS

In the present investigation, analysis of variance (ANOVA) revealed significant differences among different genotypes of orange-fleshed sweet potato (OFSP) for all the Morphological characters viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%), length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, total tuber yield

per plant (g), marketable tuber yield per hectare (t/ha). The present findings are in consonance with the earlier investigations of Kamalam, 1990, Vimala and Lakshmi, 1990, Rao *et al.* (1992), Sastry *et al.* (2007), Cavalcante *et al.* (2010), Pushpalata *et al.* (2011), Vimala and Hariprakash (2011), Richardson *et al.* (2012), Ashok *et al.* (2013), Thiyagu *et al.* (2013), Muluken Demelie and Abiyot Aragaw (2015), Shivanand *et al.* (2015), Solomon *et al.* (2015), Meenakshi *et al.* (2017), Fekadu *et al.* (2018), Sharavati *et al.* (2018), Ochieng (2019), Bililign *et al.* (2021), Rahajeng *et al.* (2021), Ashish *et al.* (2022), Bassey *et al.* (2022), Gamliel *et al.* (2022) and Harriman *et al.* (2023) in sweet potato.

The mean comparisons made among the genotypes for the morphological traits revealed the following results which were presented in the preceding chapter and are brought hereunder for discussion:

5.1.1 Vine length (cm)

Significant differences were observed for vine length among different genotypes of orange fleshed sweet potato (OFSP) at 30, 60, 90 and 120 DAP. Among the genotypes tested, TSP 16-3 recorded the maximum vine length viz., 114.70 cm, 194.00 cm, 199.80 cm and 225.20 cm, respectively at 30, 60, 90 and 120 DAP. Among all the genotypes, Bhu Ja recorded the minimum vine length viz., 34.00 cm, 40.40 cm, 45.20 cm and 61.30 cm respectively at 30, 60, 90 and 120 DAP. Vine length gradually increased up to 120 days after planting and it varied among the genotypes at different intervals.

Variation in vine length at different intervals was also observed by Engida *et al.* (2006), Shashikanth *et al.* (2008), Mohanty *et al.* (2016), Meenakshi *et al.* (2017) and Mekonnen *et al.* (2021) in sweet potato.

5.1.2 Internodal length (cm)

Significant differences were observed in internodal length among different genotypes of orange fleshed sweet potato (OFSP) at 30, 60, 90 and 120 DAP. On 30th day, among all the genotypes, TSP 16-3 recorded the maximum internodal length (5.82 cm), while Dergaon Red recorded the minimum internodal length (2.15 cm). On 60th day, among all the genotypes, TSP 16-3 recorded the maximum internodal length (8.07 cm), while Bhu Ja recorded the minimum internodal length (2.75 cm). On 90th day, among all the genotypes, TSP 16-3 recorded the maximum internodal length (10.98 cm), while Co-1 recorded the minimum internodal length (3.35 cm). On 120th day, among all the genotypes, TSP 16-3 recorded the maximum internodal length (11.91 cm), while CIPSWA-2 recorded the

minimum internodal length (3.66 cm).

In the present study, wide range of variability was observed for internodal length.

5.1.3 Vine weight (g)

Significant differences were observed in vine weight among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, S1156 recorded the maximum vine weight (570.00 g), while Gouri recorded the minimum vine weight (146.00 g). Vine weight ranged from 146.00 g to 570.00 g. It indicated the existence of wide variability, which might be amenable for further selection.

5.1.4 Fresh weight of whole plant (g)

Significant differences were observed in fresh weight of whole plant among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum fresh weight of whole plant (1537.00 g), while Gouri recorded the minimum fresh weight of whole plant (403.80 g).

5.1.5 Dry weight of whole plant (g)

Significant differences were observed in dry weight of whole plant among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, S1156 recorded the maximum dry weight of whole plant (339.80 g), while Gouri recorded the minimum dry weight of whole plant (110.10 g).

5.1.6 Plant dry matter content (%)

Significant differences were observed in plant dry matter content among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, PSP-1 recorded the maximum plant dry matter content (34.46 %), while Bhu Kanti recorded the minimum plant dry matter content (15.58 %).

5.1.7 Fresh weight of tuber (g)

Significant differences were observed in fresh weight of tuber among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum fresh weight of tuber (897.50 g), while Gouri recorded the minimum fresh weight of tuber (251.00 g).

5.1.8 Dry weight of tuber (g)

Significant differences were observed in dry weight of tuber among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, S1156 recorded the maximum dry weight of tuber (225.80 g), while Co-1 recorded the minimum dry weight of tuber (87.60 g).

5.1.9 Tuber dry matter content (%)

Significant differences were observed in tuber dry matter content among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, PSP-1 recorded the maximum tuber dry matter content (38.49%), while Bhu Kanti recorded the minimum tuber dry matter content (19.31%).

5.1.10 Tuber moisture content (%)

Significant differences were observed in tuber moisture content among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum tuber moisture content (80.89 %), while PSP-1 recorded the minimum tuber moisture content (61.51%).

5.1.11 Length of the tuber (cm)

Significant differences were observed in length of the tuber among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, Kamala Sundari recorded the maximum length of the tuber (26.66 cm), while PSP-1 recorded the minimum length of the tuber (15.95 cm).

5.1.12 Diameter of tuber (cm)

Significant differences were observed in diameter of tuber among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, CIPSWA-2 recorded the maximum diameter of tuber (6.18 cm), while TSP 16-7 recorded the minimum diameter of tuber (3.13 cm).

5.1.13 Number of tubers per plant

Significant differences were observed in number of tubers among different genotypes of orange fleshed sweet potato (OFSP) at harvesting time. Among all the genotypes, Bhu Kanti recorded the maximum number of tubers per plant (9.20), while Gouri recorded the

minimum number of tubers per plant (2.50).

5.1.14 Total tuber yield per plant (g)

Significant differences were observed in total tuber yield per plant among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum total tuber yield per plant (897.50 g), while Gouri recorded the minimum total tuber yield per plant (251.00 g).

5.1.15 Unmarketable tuber yield per plant (g)

Non-significant differences were observed in unmarketable tuber yield per plant among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, CIPSWA-2 recorded the maximum unmarketable tuber yield per plant (103.00 g), while Gouri recorded the minimum unmarketable tuber yield per plant (10.50 g).

5.1.16 Marketable tuber yield per plant (g)

Significant differences were observed in tuber marketable yield per plant among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum marketable tuber yield per plant (826.00 g), followed by CIPSWA-2 (734.50 g) and Bhu Sona (686.50 g), while Gouri recorded the minimum marketable tuber yield per plant (240.50 g).

5.1.17 Marketable tuber yield per hectare (t/ha)

Significant differences were observed in tuber marketable yield per hectare among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, Bhu Kanti recorded the maximum tuber marketable yield per hectare (58.44 t/ha), followed by CIPSWA-2 (51.96 t/ha), Bhu Sona (48.57 t/ha), while Gouri recorded the minimum marketable tuber yield per hectare (17.01 t/ha).

5.2 QUALITY PARAMETERS

ANOVA revealed significant differences among different genotypes of OFSP for all the quality traits viz., total soluble solids ($^{\circ}$ Brix), total carotenoids (mg/100g), starch (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days) indicates the presence of sufficient amount of variability in all the characters under study. The present

findings are in consonance with earlier investigations of Sahu *et al.* (2005), Pushpalata *et al.* (2011), Ali *et al.* (2015), Singh *et al.* (2015), Gupta *et al.* (2017), Meenakshi *et al.* (2017), Ramachandra and Srinivasa (2017), Bajrang Bali *et al.* (2022), Kar *et al.* (2022), Wani *et al.* (2022) and Mekonnen *et al.* (2023) in sweet potato.

The mean comparisons made among the genotypes for the quality traits revealed the following results which were presented in the preceding chapter and are brought hereunder for discussion:

5.2.1 Total Soluble Solids (°Brix)

Significant differences were observed in total soluble solids among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, TSP 16-7 recorded the maximum total soluble solids (12.35 °Brix), while Bhu Kanti recorded the minimum total soluble solids (7.00 °Brix).

5.2.2 Total carotenoids (mg/100g)

Significant differences were observed in total carotenoids among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, PSP-1 recorded the maximum total carotenoids (14.31mg/100g), while Dergaon Red recorded the minimum total carotenoids (1.06 mg/100g).

5.2.3 Starch content (%)

Significant differences were observed in starch content among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, Co-1 recorded the maximum starch content (22.75 %), while TSP 16-9 recorded the minimum starch content (10.15 %).

5.2.4 Total sugars (%)

Significant differences were observed in total sugars among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, Co-1 recorded the maximum total sugars (8.82%), while Kiran recorded the minimum total sugars (3.42%).

5.2.5 Reducing sugars (%)

Significant differences were observed in reducing sugars among different genotypes of orange fleshed sweet potato (OFSP) at the time of harvest. Among all the genotypes, Co-1 recorded the maximum reducing sugars (7.79 %), while CIPSWA-2 recorded the minimum reducing sugars (2.83 %).

5.2.6 Non-reducing sugars (%)

Significant differences were observed in non-reducing sugars. Among different genotypes of orange fleshed sweet potato (OFSP), Co-1 recorded the maximum non-reducing sugars (1.03 %), while Kiran recorded the minimum non-reducing sugars (0.40 %).

5.2.7 Shelf life (days)

Significant differences were observed in respect of shelf life among different genotypes of orange fleshed sweet potato (OFSP), Bhu Sona recorded the maximum shelf life (33.00 days), while TSP 16-3 recorded the minimum shelf life (17.50 days).

5.3 GENETIC VARIABILITY

Presence of a wide spectrum of variability in a given crop species will enhance the chance of selecting a desired genotype. In the present investigation, the moderate to high GCV indicated a moderate to high degree of genetic variability and thus offered a greater scope for selection of superior genotype (s). Besides genetic variability, knowledge on extent of heritability in broad sense and genetic advance (as per cent of mean) indicates the relative degree to which a character is transmitted from one generation to the next. High heritability indicates that a major part of the phenotypic variability in any character is controlled by genes, which can be improved by simple selection procedures (Lush, 1940). Heritability also provides information to predict genetic gain obtained by selection. Therefore, for successful improvement of any crop, it is necessary to have a thorough knowledge on the above genetic parameters. The inheritance of a character with high heritability coupled with high genetic advance as per cent of mean is controlled largely by genes with additive gene actions. The characters viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%), length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, marketable total tuber yield per plant (g), marketable tuber yield per hectare (t/ha), total soluble solids (°Brix), total carotenoids (mg/100g), starch content (%), total sugars (%), reducing sugars (%), non-

reducing sugars (%) and shelf life (days) had high heritability and high genetic advance (GAM). This in turn indicated the preponderant role of additive gene effects in the inheritance of these traits. Additive genetic effects are fixable types of gene effects and are not changed with the advancement of generations. This type of gene action offers the possibility of making plant selection in early segregating generations in a breeding programme. Burton and Devane (1953) indicated that genetic variability together with the heritability would give a better idea on the amount of genetic advance expected out of selection. The magnitude of heritable variability is the most important aspect of genetic contribution of the breeding material, which has close relationship with its response to selection (Panse, 1957).

The fourteen orange-fleshed sweet potato genotypes studied in the present investigation showed significant to highly significant for all the characters.

The population means, range, genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV), heritability, genetic advance and expected genetic advance as per cent of mean (GAM) for the different characters were studied. The PCV was higher than GCV for all the traits under study.

The results obtained on the mean, variability, heritability and genetic advance as per cent of mean are discussed hereunder.

High genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were observed for the following morpho-biochemical traits: vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), fresh weight of tuber (g), dry weight of tuber (g), diameter of tuber (cm), number of tubers per plant, total tuber yield per plant (g), marketable tuber yield per hectare (t/ha), total carotenoids (mg/100g), starch content (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days) indicating the existence of more variability for these traits in the genotypes under study.

Similar results were expressed by Rajesh kumar Jain and Ganguli (1996), Mok *et al.* (1997), Alam *et al.* (1998), Hossain *et al.* (2000), Sankari *et al.* (2001), Teshome *et al.* (2004) and Enigida *et al.* (2007), Ashok *et al.* (2013), Thiyagu *et al.* (2013), Mohanty *et al.* (2015), Tripathi *et al.* (2016), Meenakshi *et al.* (2017), Narasimhamurthy *et al.* (2018), Sharavati *et al.* (2018), Gehan, A. and Sharkawy, E.L. (2019), Pankaj Singh *et al.* (2019), Ratna *et al.* (2019) and Bililign *et al.* (2021), Pallavi Wani *et al.* (2023) in sweet potato.

Moderate genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were observed for the following morpho-biochemical traits: plant dry matter

content (%), tuber dry matter content (%), length of the tuber (cm) and total soluble solids (°Brix).

Similar findings were also observed by Gehan, A. and Sharkawy, E.L. (2019) and Bililign *et al.* (2021), Thiyagu *et al.* (2013), Tumwegamire, S. (2011), Sharavati *et al.* (2018), Pankaj Singh *et al.* (2019) and Ratna *et al.* (2019) in sweet potato.

High heritability (h^2) and genetic advance (GAM) were observed for the following morpho-biochemical traits: vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%), length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, marketable total tuber yield per plant (g), marketable tuber yield per hectare (t/ha), total soluble solids (°Brix), total carotenoids (mg/100g), starch (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days).

Presence of high heritability in conjunction with high GAM was in agreement with the earlier reports of Vimala and Lakshmi (1990), Kamalam *et al.* (1990), Choudhary *et al.* (1999), Hossain *et al.* (2000), Sankari *et al.* (2001), Endiga *et al.* (2007) and Choudhary and Mishra (2011), Tumwegamire, S. (2011), Ashok *et al.* (2013), Thiyagu *et al.* (2013), Yada, B (2014), Solankey *et al.* (2015), Tripathi *et al.* (2016), Mohanty *et al.* (2015), Meenakshi *et al.* (2017), Narasimhamurthy *et al.* (2018), Sharavati *et al.* (2018), Gehan, A. and Sharkawy, E.L. (2019), Pankaj Singh *et al.* (2019), Ratna *et al.* (2019), Bililign *et al.* (2021) and Pallavi Wani *et al.* (2023) in sweet potato.

In the present study, wide variability was recorded with vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), fresh weight of tuber (g), dry weight of tuber (g), diameter of the tuber (cm), number of tubers per plant, total tuber yield per plant (g), marketable tuber yield per hectare (t/ha) and qualitative parameters like total carotenoids (mg/100g), starch content (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days) indicating the existence of more variability for these traits in the genotypes under study as they have high PCV and high GCV. Moderate variability was recorded for plant dry matter content (%), tuber dry matter content (%), length of the tuber (cm) and total soluble solids (°Brix). High heritability coupled with high genetic advance as per cent of mean indicates operation of additive gene action as in case of vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%),

length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, tuber yield per plant (g), tuber yield per hectare (t/ha) and qualitative parameters like total soluble solids (°Brix), total carotenoids (mg/100g), starch (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days). The above findings indicated that the preponderance of additive gene action governing the inheritance of these characters and offers the best possibility of improvement through simple selection procedures and these results are in accordance with the findings of Jones, *kamalam* (1965) and Lin (1983) in sweet potato. Hence, directional selection for these traits in genetically diverse material could be effective for desired genetic improvement. Moderate PCV, GCV along with high or moderate heritability indicates action of both additive and non-additive genes.

5.4 CORRELATION COEFFICIENT ANALYSIS

Direct selection for yield and yield component traits is not effective as it is a complex morphological character and it is highly influenced by the environment. High genotype and environment interaction will restrict improvement if selection is based on yield. Thus, effective improvement in yield may be brought about through selection on yield component characters that are relatively simply inherited. Therefore, the correlation between yield and yield components is of considerable importance in the selection programme. The aim of correlation studies is primarily to know the suitability of various characters for indirect selection for improvement of complex dependent trait like yield. Thus, studies on correlation enable the breeder to know the mutual relationship between various characters and determine the component characters on which selection can be used for genetic improvement (Grafuis, 1959). Yield component characters show associations among themselves and also with yield. Unfavourable associations between the attributes under selection may limit genetic advance. Hence, knowledge of associations between the yield and yield components and also among the yield components is essential for planning a sound selection programme (Falconer, 1964).

The phenotypic (r_p) and genotypic correlation (r_g) coefficients were worked out for different morphological and quality characters in 14 orange fleshed sweet potato genotypes. In general, genotypic correlation coefficients were of higher magnitude than the phenotypic correlation coefficients and it is desirable also. This may be due to the relative stability of genotypes as majority of them were subjected to certain amount of selection (Johnson *et al.*, 1955).

In the present investigation vine length exhibited a significant positive genotypic correlation with internodal length and with total carotenoids and also recorded a significant negative genotypic correlation with starch content. Similarly, Muluken, D. and Abiyot, A. (2016) reported a significant positive genotypic correlation between vine length and internodal length. These results are in agreement with the findings of Solankey *et al.* (2015) and Fekuda *et al.* (2018) with internodal length in sweet potato. Vine weight per plant exhibited a significant positive correlation with fresh weight of whole plant, dry weight of whole plant, fresh weight of tuber, dry weight of tuber, and marketable tuber yield per plant. Gehan, A. and Sharkawy, E.L. (2019) reported significant positive correlation for vine weight per plant with tuber yield per plant. Fresh weight of whole plant exhibited a significant positive correlation with the dry weight of the whole plant, fresh weight of tuber, marketable tuber yield per plant, dry weight of tuber. This character also recorded a significant negative correlation with plant dry matter content. It is in conformity with the results of Meenakshi *et al.* (2018) and Perez *et al.* (2001) in sweet potato. Gehan, A. and Sharkawy, E.L. (2019) reported significant positive correlation for fresh weight of whole plant with tuber yield per plant. Sahu *et al.* (2005) and Fekuda *et al.* (2018) reported significant positive correlation for fresh weight of whole plant with tuber diameter. Dry weight of whole plant exhibited significant positive correlation with dry weight of tuber, diameter of tuber, fresh weight of tuber and marketable tuber yield per plant. Plant dry matter content exhibited significant positive correlation with tuber dry matter content and total carotenoids and a significant negative correlation with fresh weight of tuber, number of tubers per plant and with marketable tuber yield per plant. Similarly, Rao *et al.* (2015) reported significant positive correlation for plant dry matter content with tuber dry matter content in cassava. Fresh weight of tuber exhibited significant positive correlation with dry weight of tuber and marketable tuber yield per plant and with diameter of tuber and number of tubers per plant and a significant negative correlation with tuber dry matter content. It is in conformity with the results of Meenakshi *et al.* (2018), Perez *et al.* (2001) in sweet potato. The fresh weight of tuber with diameter of tuber and marketable tuber yield per plant are in agreement with the findings of Fekuda *et al.* (2018) in sweet potato. Dry weight of tuber exhibited significant positive correlation with diameter of tuber and marketable tuber yield per plant. Tuber dry matter content exhibited significant positive correlation with diameter of tuber and total carotenoids. The result for tuber dry matter content with diameter of tuber is in accordance with the findings of Fekadu *et al.* (2018). Kamalam *et al.* (1977), Birhanu *et al.* (2018) and Islam *et al.* (2002) observed similar results for tuber dry matter content

with number of tubers per plant in sweet potato.

The diameter of the tuber exhibited a positive significant correlation with starch content and marketable tuber yield per plant. Positive correlation for this trait with tuber yield per plant is in conformity with the results of Pushkaran *et al.* (1976), Kamalam *et al.* (1977), Ibrahim (1987), Hossain *et al.* (2000), Engida *et al.* (2005) and Meenakshi *et al.* (2018). A significant positive correlation for the diameter of tuber with root tuber yield per hectare is in agreement with the results of Naskar *et al.* (1986), Jain and Ganguli (1996) and Meenakshi *et al.* (2018). The diameter of the tuber was positively and significantly correlated with marketable tuber yield per plant which may suggest that improvement aimed at any of the characters would automatically lead to improvement in the other. Marketable tuber yield per plant exhibited positive significant correlation with vine weight per plant, fresh weight of plant, dry weight of plant, fresh weight of tuber, dry weight of tuber and diameter of tuber. This trait also showed significant negative correlation with plant dry matter content and tuber dry matter content. Sahu *et al.* (2005) reported significant positive correlation for tuber yield per plant with diameter of tuber. Negative correlation for marketable tuber yield per plant with tuber dry matter content in the present study was in agreement with the findings of Li, L. (1982), Engida *et al.* (2004) and Birhanu *et al.* (2018).

The genotypic correlation results obtained in the present study indicated that parameters viz., vine weight per plant, fresh weight of plant, dry weight of plant, fresh weight of tuber, dry weight of tuber and diameter of tuber were the important determinants of tuber yield as they showed positive significant association with marketable tuber yield. Therefore, to increase yield in sweet potato, the above-mentioned attributes could be used for selection. Genotypic correlation of two traits results from genetic linkage, pleiotropy or both. Selection of plants with higher values of vine weight, fresh weight of plant, dry weight of plant, fresh weight of tuber, dry weight of tuber, and tuber diameter would result in plants with higher marketable tuber yield due to correlated response resulting from either genetic linkage or pleiotropy or both.

5.5 PATH COEFFICIENT ANALYSIS

The observed correlation between yield and its component character is the net result of the direct and indirect effects of the component character through other yield attributes. The total correlation coefficient between yield and its component characters may some times be misleading, as it may be an over or under estimate of its association with other characters. In these cases, direct selection on the basis of correlated response may not be fruitful. For

critical evaluation, the correlation coefficient need to be split into direct and indirect effects using path coefficient analysis since, many characters affect a given trait. Thus, the correlation and path coefficients in combination can give a better insight into cause and effect relationship between different pairs of characters.

As a guideline for interpretation of the results of path analysis, the following broad points may be kept in view (Singh and Chaudhary, 1977). If the correlation coefficient between a causal factor and the effect is almost equal to its direct effect, then correlation explains the true relationship and a direct selection through that trait will be effective. If the correlation coefficient is positive, but the direct effect is negative or negligible, the indirect effects seems to be the cause of positive correlation. In such situations, the indirect causal factors are to be considered simultaneously for selection. Correlation coefficient may be negative but the direct effect is positive and high, under these circumstances, a restricted simultaneous selection model is to be followed *i.e.*, restrictions are to be imposed to nullify the undesirable indirect effects in order to make use of the direct effect. If correlation coefficient is negative and direct effect is also negative, then drop the selection based on that character. The residual effect determines how best the causal factors account for the variability of the dependent factor. If the residual effect is high, some other factors which have not been considered here need to be included in this analysis to account fully for the variation in yield.

Based on the above, the characters subjected to correlations were also subjected to path coefficient analysis for estimating the direct and indirect effects so as to formulate a basis for selection in sweet potato. In order to fulfill the requirement, the path coefficient analysis was computed and direct and indirect effects of different characters on tuber yield per hectare.

In the present study, path coefficient analysis between the components of sweet potato was worked out for marketable tuber yield at both phenotypic and genotypic level. Present investigation revealed that out of fourteen characters studied the character internodal length, fresh weight of the whole plant, plant dry matter content, dry weight of the tuber, and diameter of the tuber positively contributed towards marketable yield per plant at both phenotypic and genotypic levels. This indicated the true positive association with marketable yield per hectare. Therefore, direct selection for these traits would reward for improvement of yield.

5.5.1 DIRECT AND INDIRECT EFFECTS

In the present study, Vine weight per plant showed high negative direct effect on marketable tuber yield per plant at both phenotypic and genotypic levels. Fresh weight of whole plant showed very high positive direct effect on marketable tuber yield per plant at both phenotypic and genotypic levels. Bilate *et al.* (2022) observed similar results for fresh weight of whole plant in cassava. Dry weight of whole plant exhibited very high negative direct effect on marketable tuber yield per plant at genotypic level and low negative direct effect at phenotypic level. Plant dry matter content exhibited high positive direct effect on marketable tuber yield per plant at both phenotypic and genotypic levels. These results are in accordance with the findings of Grace *et al.* (2016) in sweet potato.

Very high negative direct was expressed by fresh weight of tuber with marketable tuber yield per plant at genotypic level and negligible positive direct effect at phenotypic level only. These results were in agreement with the findings of Muhammad and Yahaya (2018) and Kelilachew *et al.* (2021) in sweet potato and Habtamu and Leta (2022) in potato. Dry weight of tuber had very high positive direct effect on marketable tuber yield per plant at genotypic level and high positive direct effect at phenotypic level. Tuber dry matter content showed high negative direct effect on marketable tuber yield per plant at genotypic level and low negative direct effect at phenotypic level. Mohanty *et al.* (2016) reported negligible negative direct effect at phenotypic level in sweet potato.

Length of the tuber showed negligible negative direct effect on marketable tuber yield per plant at both phenotypic and genotypic levels indicating that there would not be considerable decrease in the marketable tuber yield had the tubers been longer. Similar results were reported by Sahu *et al.* (2005) in sweet potato. However, in contradiction, Mohanty *et al.* (2016) reported positive direct effect in sweet potato. Diameter of tuber showed high positive direct effect with marketable tuber yield per plant at both phenotypic and genotypic levels indicating that selection of plants with wider tubers would result in plants with high marketable tuber yield. These results were in accordance with the findings of Grace *et al.* (2016) in sweet potato and Mulaulem and Ayenew (2012) and Babu Rao *et al.* (2015) in cassava. Bilate *et al.* (2022) observed moderate positive direct effect for diameter of tuber on marketable tuber yield per plant in cassava. Number of tubers per plant showed high negative direct effect on marketable tuber yield per plant at genotypic level and moderate negative direct effect at phenotypic level. As tubers per plant is an important key trait for tuber yield enhancement based on a number of previous literature this experimental result indicated that the breeder should look in to other traits with high indirect effects as

well as with high heritability. Kelilachew *et al.* (2021) in sweet potato and Bilate *et al.* (2022) observed negligible negative direct effect for number of tubers per plant in cassava. These results were in contradictory to the findings of Alam *et al.* (1998), Parida *et al.* (1999) and Sahu *et al.* (2005) and Mohanty *et al.* (2016) where they have observed a positive direct effect of number of tubers per plant on tuber yield in sweet potato.

Total carotenoids showed negligible negative direct effect on marketable tuber yield per plant at both phenotypic and genotypic level. These results were in accordance with the findings of Solankey *et al.* (2015) and Mohanty *et al.* (2016) in sweet potato. Starch content showed moderate negative direct effect on marketable tuber yield per plant at phenotypic and low negative direct effect at genotypic level. Solankey *et al.* (2015) observed negative direct effect for starch on marketable tuber yield per plant in sweet potato. Similarly, Habtamu, G. and Leta, A. (2022) reported negligible negative direct effect for starch on tuber yield per plant in potato.

The results obtained from path coefficient analysis revealed that internodal length showed positive direct effect on marketable tuber yield per plant due to its positive indirect effects through vine weight per plant, dry weight of the whole plant, tuber dry matter content, diameter of the tuber and starch content. Fresh weight of whole plant showed very high positive direct effect on marketable tuber yield per plant due to its indirect positive effects through dry weight of the tuber, tuber dry matter content and total carotenoids. Plant dry matter content exhibited high positive direct effect on marketable tuber yield per plant at both phenotypic and genotypic levels due to its positive indirect effects through vine weight per plant, fresh weight of the tuber, length of the tuber and number of tubers per plant. Dry weight of tuber had very high positive direct effect on marketable tuber yield per plant at genotypic level and high positive direct effect at phenotypic level due to its positive indirect effects through fresh weight of the plant, plant dry matter content and length of the tuber. Diameter of tuber showed high positive direct effect with marketable tuber yield per plant at both phenotypic and genotypic levels due to its positive indirect through fresh weight of the plant, plant dry matter content and dry weight of tuber.

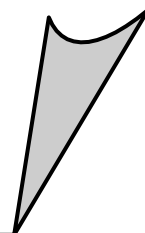
In plant breeding, it is very difficult to have complete knowledge of all component traits of yield. The residual effect permits precise explanation about the pattern of interaction of other possible components of yield. In other words, residual effect measures the role of possible independent variables which were not included in the study. In the present study, the residual effect values were (0.066) at phenotypic and (0.023) at genotypic level, respectively. This clearly showed the importance of inclusion of some more characters for

clear partitioning of the direct and indirect effects among the yield components.

The association of different component characters among themselves and with yield is quite important for devising an efficient selection criterion for yield. The total correlation between yield and its component characters may sometimes be misleading, as it might be an over-estimate or under-estimate because of its association with other characters. Hence, indirect selection by correlated response may not sometimes be fruitful. When many characters are affecting a given character, splitting the total correlation into direct and indirect effects of cause as devised by Wright (1921) would give more meaningful interpretation to the cause of association between the dependent variable like yield and independent variables like yield components. This kind of information will be helpful in formulating the selection criteria. The selection for these characters is likely to bring about an overall improvement in single plant yield directly.

The path analysis indicated that internodal length, fresh weight of the whole plant, plant dry matter content, dry weight of the tuber and diameter of the tuber had direct positive effects on marketable tuber yield per plant at both phenotypic and genotypic levels. Based on the results of path analysis, the present study revealed that major emphasis should be laid on the selection process with more internodal length, fresh weight of the whole plant, plant dry matter content, dry weight of the tuber, the diameter of the tuber and there should be an economic balance among these traits to get higher marketable tuber yield per plant.

Summary and Conclusion...✍



CHAPTER VI

SUMMARY AND CONCLUSION

The present experiment entitled ‘Performance of orange-fleshed sweet potato (*Ipomea batatas* L.) genotypes for yield and yield attributing characters’ was carried out with the principle objective to study the variability, character association and path analysis for Morphological and quality parameters at an Experimental Farm, Department of Horticulture, Assam Agricultural university, Jorhat during the year 2022-2023. The experiment was laid under Randomized Block Design (RBD) with two replications and 14 treatments consisting of 14 orange fleshed sweet potato genotypes procured from AICRP on tuber crops of different centers. Observations were recorded on different Morphological parameters viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%), length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, total tuber yield per plant (g), unmarketable tuber yield per plant (g), unmarketable tuber yield per hectare (t/ha), marketable tuber yield per plant (g), marketable tuber yield per hectare (t/ha) and quality parameters like total soluble solids (°Brix), total carotenoids (mg/100g), starch content (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days). The data were subjected to statistical analysis to get the information regarding Morphological and quality variability among fourteen genotypes. Finally, data was subjected to statistical analysis by applying statistical procedure for study of genetic variability, genotypic and phenotypic coefficient of variance, heritability, genetic advance, correlation and path coefficient analysis for above characters.

Analysis of variance revealed highly significant difference among genotypes for all the Morphological and quality parameters. The phenotypic coefficient of variation was higher than genotypic coefficient of variation for all the traits. High (>20 %) Genotypic Coefficient of Variation (GCV) and Phenotypic Coefficient Variation (PCV) were observed for Morphological parameters viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), fresh weight of tuber (g), dry weight of tuber (g), diameter of tuber (cm), number of tubers per plant, tuber yield per plant (g), total tuber yield per hectare (t/ha), marketable tuber yield per plant (g),

marketable tuber yield per hectare (t/ha) and quality parameters like total carotenoids (mg/100g), starch content (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days) indicating the existence of more variability for these traits in the genotypes under study as these have high PCV and high GCV. Moderate variability was recorded for plant dry matter content (%), tuber dry matter content (%), length of the tuber (cm) and total soluble solids (°Brix). High heritability coupled with high genetic advance as per cent of mean indicates operation of additive gene action as in case of vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%), length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, marketable tuber yield per plant (g), marketable tuber yield per hectare (t/ha) and quality parameters like total soluble solids (°Brix), total carotenoids (mg/100g), starch content (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days). Hence, directional selection for these traits in genetically diverse material could be effective for desired genetic improvement. Moderate genetic advance as per cent of mean with high or medium heritability indicates action of both additive and non-additive genes as in case of which offers the best possibility of improvement through mass selection and progeny selection.

In the present study, high heritability (>60 %) coupled with high genetic advance as per cent over mean (>20 %) were recorded for the characters viz., vine length (cm), internodal length (cm), vine weight per plant (g), fresh weight of whole plant (g), dry weight of whole plant (g), plant dry matter content (%), fresh weight of tuber (g), dry weight of tuber (g), tuber dry matter content (%), length of the tuber (cm), diameter of tuber (cm), number of tubers per plant, tuber yield per plant (g), tuber yield per hectare (t/ha) and quality parameters like total soluble solids (°Brix), total carotenoids (mg/100g), starch content (%), total sugars (%), reducing sugars (%), non-reducing sugars (%) and shelf life (days). Hence, directional selection for these traits in genetically diverse material could be effective for desired genetic improvement. Moderate genetic advance as per cent of mean with high or medium heritability indicates action of both additive and non-additive genes as in case of which offers the best possibility of improvement through mass selection and progeny selection.

Correlation study indicated that genotypic correlation coefficients were higher than phenotypic correlation coefficients indicate the lesser influence of the environment in the expression of these traits and presence of strong inherent association among the traits.

Tuber yield per plant exhibited positive significant correlation with vine weight per plant, fresh weight of plant, dry weight of plant, fresh weight of tuber, dry weight of tuber and diameter of tuber at both phenotypic and genotypic levels. This indicated the presence of very strong association among the characters. Correlation study revealed that yield can be improved by selecting genotypes having more vine weight per plant, fresh weight of plant, dry weight of plant, fresh weight of tuber, dry weight of tuber and diameter of tuber.

The highest positive direct effects on tuber yield per plant was shown by fresh weight of whole plant, plant dry matter content, dry weight of tuber and diameter of tuber. The highest negative direct effects were exhibited by vine weight per plant, dry weight of whole plant, tuber dry matter content and number of tubers per plant. Characters having high positive direct effects along with positive significant correlation with marketable yield per hectare can be directly selected and simultaneously the characters which show high positive indirect effects can also be selected for the improvement of yield.

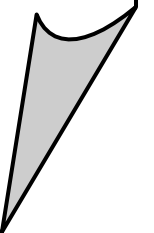
Considering all factors, it could be concluded that the genetic stocks of orange fleshed sweet potato used in this investigation had wide range of variation for Morphological and quality characters. After evaluation of tuber yield and its component characters, Bhu kanthi and Bhu Sona performed well regarding diameter of tuber, tuber yield per plant and tuber yield per hectare. As such, there is enough scope for improvement of these characters by selection.

FUTURE LINE OF WORK

The genotypes studied in present investigation had very high variability and heritability for yield and its component characters. Further,

- The same study has to be carried out by using the promising genotypes for one or two seasons to know the stable expression of the characters and future hybridization programme.
- Yield contributing characters like fresh weight of whole plant, dry weight of whole plant, fresh weight of the tuber, dry weight of the tuber, number of tubers per plant, length of the tuber, diameter of the tuber and tuber yield per plant are the most dependable characters and could be effectively used in breeding for improvement in yield.
- Breeding for high total carotenoids content with high sugar content and more yield should be taken care which will be helpful to increase the future demand for orange fleshed sweet potato varieties in fortification of foods.

Bibliography... 



BIBLIOGRAPHY

- Afuape, S.O., Okocha, P.I. and Njoku, D. (2011). Multivariate assessment of the agro morphological variability and yield components among sweet potato (*Ipomoea batatas* L.) landraces. *African J. Plt. Sci.*, **5**(2): 123-132.
- Akkamahadevi, B., Neera Rao, P., Shrinivasan, C.N. and Pushpa Bharti. (1996). Composition and cooking quality of five sweet potato varieties. *J. Root Crops.*, **22**(2): 101-104.
- Alam, S., Narzary, B.D. and Deka, B.C. (1998). Variability, character association and path analysis in sweet potato (*Ipomoea batatas* (L.) Lam.). *J. Agric. Sci. Soc. of North East India.*, **11**(1): 77-81.
- Ali, S., Mohammed, W. and Shimelis, B. (2015). Agronomic and physicochemical evaluation of sweet potato [*Ipomoea batatas* (L.) Lam.] collections in Ethiopia. *Adv. Crop Sci. Tech.*, **3**:3.
- Allard, R.W. (1960). *Principles of plant breeding*. John Wiley & Sons, New York.USA.
- Amarchandra. (1997). Yield prediction of sweet potato (*Ipomoea botatas* (L.) Lam.) based on physiological and yield parameters. *JNKVV Res. J.*, **31**: 1-5.
- Anonymous. National Horticulture Board. (2022). Final estimates of commodity wise status. *Indian Horticulture Database*.
- Anuj K.C. and Singh, A.K. (2013). Selection criteria for higher marketable tuber yield of orange fleshed sweet potato. *Madras Agric. J.*, **100**(4-6): 361-364.
- AOAC. (1965). *Official Methods of Analysis*. Association of Official Analytical Chemists. Washington, DC.USA.
- Ara, T., Haydar, A., Islam, M.A., Azad, M.A.S. and Khokan, E.H. (2009). Path analysis in potato. *J. Soil Nature.*, **3**(2): 20-23.
- Ashish, N., Dileep, K., Alam, T., Singh, R.S., Giri, G.S., Prasad, R. and Singh, P.P. (2022). Genetic diversity in sweet potato (*Ipomea batatas* L.). *Pharma Innovation.*, **11**(6): 2352-2355.
- Ashok, P., Sasikala, K. and Netra Pal. (2013). Growth analysis studies in onion (*Allium cepa* L). *Int. J. Farm Sci.*, **3**(1): 30-46.
- Babu Rao, B., Ashok, P., Ramanandam, G. and Sasikala, K. (2015). Trait association and path coefficient analyses in cassava. *Int. J. Veg. Sci.*, **21**(4): 402-415.
- Babu Rao, B., Swami, D.V., Ashok, P., Kalyana Babu, B., Ramajayam, D. and Sasikala, K. (2017). Correlation and path coefficient analysis of cassava (*Manihot esculenta* Crantz) genotypes. *Int. J. Curr. Microbiol. App. Sci.*, **6**(9): 549-557.
- Bacusmo, J.L. and Carpana, A.L. (1982). Morphological and agronomic traits associated with yield performance of sweet potato. *Ann. Trop. Res.*, **4**(2): 92-102.

- Bajrang, B., Padmakshi, T., Neeraj, S., Deo, S. and Sonali, K. (2022). Genetic variability for different quantitative characters in sweet potato (*Ipomoea batatas* L.). *Electron. J. Plant Breed.*, **13**(2): 506-511
- Bassey, E.E., Nwankwo, I.I.M. and Harry, G.I. (2022). Field evaluation of 25 sweet potato genotypes for qualitative and quantitative characters, biotic reactions and starch contents in Uyo, South Eastern Nigeria. *Journal of agriculture and aquaculture.*, **4**(2): 1-11.
- Bhagsari, A.S. and Harman, S.A. (1982). Photosynthesis of photosynthate partitioning in sweet potato genotypes. *J. Am. Soc. Hortic. Sci.*, **107**: 506.
- Bilate, B., Belew, D., Mulualem, T. and Abteu, W.G. (2022) Correlation and path coefficient analysis for root yield and related characters of cassava (*Manihot esculenta* Crantz) accessions in Southwest Ethiopia. *Adv. Crop. Sci. Tech.*, **10**: 518.
- Bililign, M., Gedebo, A. and Gurmu, F. (2021). Genetic variability for yield and yield related traits in orange-fleshed sweet potato genotypes evaluated at Hawassa, Ethiopia. *Agriculture, Forestry and Fisheries.*, **10**(1): 28-35.
- Birhanu, A., Fetien, A. and Yemane, T. (2018). Interrelationships of sweet potato varieties and their characters for yield determination. *Int. J. Sci.: Basic Appl. Res.*, **37**(2): 261-274.
- Bourke, R.M. (1984). Growth analysis for four sweet potato cultivars in Papua Newguinea. *Trop. Agric.*, **63**(3): 177-181.
- Burton, G.W. (1952). Quantitative inheritance in grasses. *Proceeding of the sixth International Grassland Congress.*, **1**: 277-283.
- Burton, G.W. and Devane, E.H. (1953). Estimating the heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. *Agron. J.*, **45**: 478-481.
- Cavalcante, M., Ferreira, P.V., Paixao, S.L., Costa, J.G., Pereira, R.G. and Madalena, J.A. (2010). Agronomic performance, genetic dissimilarity and parental selection of sweet potato for hybridization. *Rev. Bras. Cienc. Agrar.*, **5**(4): 485-490.
- Chen Feng Xiang., Chen Yan Qing., Yuan Zhao Nian. and Lin Wen Xin. (1995). Genetic parameter, correlation and path analysis of major quantitative traits of mass crossing generations in sweet potato. *Journal of Fujian Agricultural University.*, **24**(3): 257-261.
- Chikoti, P.C., Shanahan, P. and Melis, R. (2016). Evaluation of cassava genotypes for resistance to cassava mosaic disease and agronomic traits. *Am. J. Plant Sci.*, **7**: 1122-28.
- Choudhary, A.K. and Mishra, S.B. (2011). Character association and path analysis study in sweet potato (*Ipomoea batatas* (L.) Lam). *Environ. Ecol.*, **29**(1A): 435-438.
- Choudhary, S.C., Harsh Kumar Kumar, M., Verma, V.S. and Nasar, S.K.T. (1999). Genetic variability in sweet potato (*Ipomoea batatas* (L.) Lam.). *J. Appl. Biol.*, **9**(2): 146-148.

- Choudhary, S.C., Harsh Kumar Verma, V.S. and Nasar, S.K.T. (2000). Correlation and path analysis in sweet potato (*Ipomoea batatas* (L.) Lam). *Research Journal of Birsa Agricultural University.*, **12**(2): 239-242.
- Cochran, G.W. and Cox, G.M. (1950). *Experimental Designs*. John Wiley and Sons, New York, pp 45-47.
- Dabholkar, A.R. (1992). Elements of biometrical genetics. South Asia Books Publications, New Delhi. India., pp 431.
- Danquah, J.A., Gracen, V.E., Offei, S.K., Asante, I.K. and Aduening, J.M. (2016). Agronomic performance and genotypic diversity for morphological traits among cassava genotypes in the Guinea Savannah Ecology of Ghana. *J. Crop Sci. Biotechnol.*, **19**(1): 99-108.
- Darshan, S., Arya, K., Sheela, M.N., Koundinya, A.V.K. and Hegde, V. (2017). Genetic variability studies in F1 seedlings of cassava (*Manihot esculenta* Crantz) based on morphological traits. *Int. J. Curr. Microbiol. Appl. Sci.*, **6**(5): 1855-1859.
- Dewey, D.R. and Lu, K.H. (1959). Correlation and path analysis of components of crested wheat grass seed production. *Agronomy Journal.*, **51**: 515-518.
- Engida Tsegaye. (2004). Variability and interrelationships among agronomic traits in sweet potato (*Ipomoea batatas* (L.) Lam). M.Sc. Thesis. Alemaya University of Agriculture, Alemaya, Ethiopia, pp 33-56.
- Engida, T., Dechassa, N. and Devakara Sastry, E.V. (2007). Genetic variability for yield and other agronomic traits in sweet potato. *J. Agron.*, **6**(1): 94-99.
- Engida, T.E.V., Sastry, D. and Dechassa, N. (2006). Correlation and path analysis in sweet potato and their implications for clonal selection. *J. Agron.*, **5**(3): 391-395.
- Falconer, D.S. (1964). An introduction to quantitative genetics. 2nd edition. Oliver and Boyd Ltd, Edinburgh, pp 312-324.
- Falconer, D.S. (1989). Introduction to quantitative genetics. Longman Group Limited, England, pp 48-263.
- Fekadu, G., Hussein, A., Shimelis. and Mark, D.L. (2018). Correlation and path-coefficient analyses of root yield and related traits among selected sweet potato genotypes. *S. Afr. J. Plant Soil.*, **35**(3): 179-186.
- Fisher, R.A. and Yates, F. (1963). Statistical tables for biological, agricultural and medical research. Oliver and Boyd, London, pp 46-63.
- Gehan, A. and Sharkawy, E.L. (2019). Assessment of variability, correlation and response to selection in four cultivars of sweet potato "*Ipomia batata*, L." under Alexandria environmental condition. *Alex. J. Agric. Sci.*, **64**(1): 21-31.
- Gerpacio-Santa-Crus-MTL and Chujoy, E. (1994). Heritability estimates of some root characters in sweet potatoes. *Philipp. J. Crop. Sci.*, **19**(1): 27-32.

- Gin, G., Devi, A.K.B. and Singh, N.B. (2008). Genetic variability and correlation studies in sweet potato. *Orissa J. Hortic.*, **36**(2): 73-76.
- Grace, O.N., Innocent Ifeanyi M.N. and Godson E.N. (2016). Correlation and path coefficient studies for selecting traits contribution to root yield in sweet potato genotypes (*Ipomoea batatas* Lam). *Int. J. Curr. Res.*, **8**(5): 31414-31418.
- Grafuis, J.E., (1959). Heterosis in barley. *Agronomy Journal.*, **51**: 554-567.
- Gupta, S., Pareek, S., Ameta, K.D., Sarolina, D.K., Kaushik, R.A., Shukla, K.B. and Pilania, S. (2017). Influence of different germplasm on physiological and biochemical characters in sweet potato [*Ipomoea batatas* (L.) Lam.]. *J. Pharmacognosy and Phytochem.*, **6**(6): 799-802.
- Habtamu, G and Leta, A. (2022). Correlation, path coefficient and multivariate analysis for yield and yield- associated traits among potato (*Solanum tuberosum* L.) genotypes grown in Eastern Ethiopia. *World J. Agri. and Soil Sci.*, **8**(2):1-7.
- Hallauer, A.R. and Miranda, J.B. (1982). Quantitative genetics in Maize breeding. IOWA State University Press, Ames, IOWA.
- Harriman, J.C., Okocha, P.I. and Nwofia, G.E. (2023). Analyzing genetic variation for important yield-contributing attributes in genotypes of orange-fleshed sweet potatoes. *J. Appl. Biotechnol. Bioeng.*, **10**(2): 45-49.
- Hossain, M.D., Robbani, M.G. and Mollah, M.L.R. (2000). Genetic variability correlation and path analysis of yield contributing character in sweet potato [*Ipomoea botatas* (L.) Lam.]. *Pakistan J. Sci. and Res.*, **43**(5): 314-318.
- Ibrahim, K.K. (1987). Correlation, causation and predictability for yield in sweet potato (*Ipomoea batatas* (L.) Lam.). *J. Root Crops.*, **13**(1): 21-24.
- Islam, M.J., Haque, M.Z., Majumder, U.K., Haque, M.M. and Hossain, M.F. (2002). Growth and yield potential of nine selected genotypes of sweet potato. *Pak. J. Biol. Sci.*, **5**(5): 537-538.
- Janssens, M.J.J. (1982). Sweet potato improvement in Rwanda. *In root crops in Eastern Africa proceeding of workshop*. I.D.R.C., pp 27-32.
- JHA, G. (2012). Increasing productivity of sweet potato (*Ipomoea batatas* L.) through clonal selection of ideal genotypes from open pollinated seedling population. *Int. J. Farm Sci.*, **2**(2):17-27.
- Johnson, H.W., Robinson, H.F. and Comstock, R.E. (1955). Estimates of genetic and environmental variability in soybean. *Agronomy Journal.*, **47**: 314-318.
- Jones, A. (1965). A proposed breeding procedure for sweet potato. *Crop Sci.*, **5**: 191-192.
- Kamalam, P. (1990). Variation for quantitative traits in the first clonal generation of the open pollinated progenies of sweet potato. *J. Root Crops.*, ISRC National Symposium, pp 49-52.

- Kamalam, P., Biradar, R.S., Hrishi N. and Rajendran, P.G. (1977). Path analysis and correlation studies in sweet potato (*Ipomoea batatas* Lam.). *J. Root Crops.*, **3**(1): 5-11.
- Kar, D.S., Panda, C.M., Sahu, G.S., Tripathy, P., Das, A.K., Sahu, S. and Mohanty, A. (2022). Assessment of growth and yield of sweet potato genotypes. *Int. J. Environ. Clim. Change.*, **12**(11): 3650-3656.
- Karyeija, R.F., Gibson, R.W. and Valkonen, J.P.T. (1998). Significance of sweet potato feathery mottle virus in subsistence sweet potato production in Africa. *Plt. Dis.*, **82**:4-15.
- Kelilachew Tadesse. (2021). Genetic variability and association among yield and yield related traits in sweet potato [*Ipomoea Batatas* (L.) Lam.] accessions from East and West Hararge. M.Sc. Thesis.
- Kumar, R., Jain, B.P. and Ganguli, D.K. (1996). Variability, character association and path analysis in sweet potato. In *Tropical tuber crops. Problems, prospects and future strategies*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi and Calcutta., **4**:140-145.
- Kundy, A.C., Mkamilo, G.S. and Misangu, R.N. (2014). Correlation and path analysis between yield and yield components in cassava (*Manihot esculenta* Crantz) in Southern Tanzania. *J. Natural Sci. Res.*, **4**(12): 6-10.
- Kundy, A.C., Mkamilo, G.S. and Misangu, R.N. (2015). Genetic variability among six traits in twelve cassava (*Manihot esculenta* Crantz) genotypes in Southern Tanzania. *J. Nat. Sci. Res.*, **5**(12): 33-38.
- Lenka, D. and Mishra B. (1973). Path coefficient analysis of yield in rice varieties. *Indian J. Agric. Sci.*, **43**: 376-79.
- Li Yun Song., JiXuan Deng., Kuan Ping. and Huang Tuan. (2010). Genetic effect of main agronomic characters of sweet potato in Guizhou. *Guizhou Agricultural Sciences.*, **8** (10):12-13.
- Li, L. (1982). Breeding for increased protein content in sweet potato. Proceedings of the first symposium, AVRDC, Taiwan, China, pp 335-354.
- Lin, P.S. (1983). Study on the heritability of the major characters in sweet potato and correlation between them. *J. Hortic. Sci.*, **5**(6): 12-16.
- Lush, J.L. (1940). Intra-sire correlation on regression off-spring on dams as a method of estimating heritability of characters. *Proceedings of American Society of Animal Production.*, **33**: 292-301.
- Maluf, W.R., Miranda, J.E.C. and Ferreir, P.E. (1983). Broad sense heritabilities of root and vine traits in sweet potato. *Brazilian Journal of Genetics.*, **6**(3): 443-451.
- Mc Cready R. M., Guggolz, J. and Vernon Silvieira. H. (1950). Determination of starch and amylase in vegetables. *Annals of Chemistry.*, **22**(9): 1156-1158.

- Meenakshi, B, Ashok, P., Kiran Patro, T.S.K.K. and Sasikala, K. (2018). Correlation between physiological and yield attributes of orange flesh sweet potato (*Ipomoea batatas* (L.) Lam.) genotypes. *Int. J. Pure App. Biosci.*, **6**(1): 1362-1367.
- Menaksi, B., Ashok P., Kiran Patro T.S.K.K. and Sasikala K. (2017). Studies on genetic variability, heritability and genetic advance for growth, yield and quality parameters among orange flesh Sweet Potato [*Ipomoea batatas* (L.) Lam.] genotypes. *Int. J. Curr. Microbiol. App. Sci.*, **6**(9): 1894-1903.
- Mishra, S., Singh, J. and Sharma, P.K. (2017). Studies on parameters of genetic variability for yield and its attributing traits in Potato (*Solanum tuberosum* L.). *Biosci. Biotechnol. Res. Asia.*, **14**(1): 1-6.
- Mohammed, W., Ali, S., Shimelis, B. and Burga, S. (2015). Genetic diversity of local and introduced sweet potato (*Ipomoea batatas* (L.) Lam.) collections for agro-morphology and physicochemical attributes in Ethiopia. *Sci. Technol. Arts Res. J.*, **4**(1): 09-19.
- Mohanty, P., Ashok, P., Rout, M.K. and Sasikala, K. (2016). Character association and path analysis of sweet potato [*Ipomoea batatas* (L.) Lam.] genotypes. *J. Crop Weed.*, **12**(1):76-80.
- Mohanty, P., Ashok, P., Rout, M.K. and Dash, R.K. (2015). Genetic variability for yield and yield attributing characters in sweet potato (*Ipomoea batatas* (L.) Lam.). *Trends. Biosci.*, **8**(9): 2426-2429.
- Mok, G., Tjintokohadi, N.L. and Hoang, T.D. (1997). Sweet potato breeding strategy and germplasm testing in Southeast Asia. International potato center, program report, 1995-96, Lima, Peru, pp 104-109.
- Mondal, M.A.A., Islam, M.K., Saha, M.K., Haydar, A. and Mannaf, M.A. (2009). Genetic variability, character association and path analysis of yield components in potato. *J. Sher-e-Bangla Agric. Univ.*, **3**(2): 14-18.
- Muhammad, Z.Y. and Yahaya, S.U. (2018). Correlation and path coefficient analysis for some selected growth, yield traits and root yield in Sweet Potato (*Ipomoea Batatas* [L.] Lam) cultivars. *Faman Journal.*, **18**(1): 62-72.
- Mukherjee, D., Roquib, A., Das, N.D. and Mukherjee, S. (2016). A Study on genetic variability, character association and path co-efficient analysis on morphological and yield attributing characters of taro [*Colocasia esculenta* (L.) Schott]. *American J. Plt. Sci.*, **7**: 479-488.
- Mulualem, T. and Ayenew, B. (2012). Correlation and path coefficient analysis of cassava (*Manihot esculenta* Crantz) at Jimma, Southwestern, Ethiopia. *J. Nat. Sci. Res.*, **2**(9): 1-7.
- Muluken, D. and Abiyot, A. (2016). Genetic variability of Sweet Potato on yield and yield related traits at werer Agricultural Research Center, Ethiopia. *Electron. J. Plant Breed.*, **7**(2): 362-370.
- Nanda, H.C. (1994). Correlation and path studies for yield and its components in rainfed sweet potato. *J. Root Crops.*, **20**(2): 135-137.

- Narasimhamurthy, P.N., Patel, N.B., Patel, A.I. and Koteswara Rao, G. (2018). Genetic variability, heritability and genetic advance for growth, yield and quality parameters among sweet potato [*Ipomoea batatas* (L.) Lam.] genotypes. *Int. J. Chem. Stud.*, **6**(4): 2410-2413.
- Naskar, S.K., Ravindran, C.D. and Srinivasan, G. (1986). Correlation and path analysis in sweet potato. *J. Root Crops.*, **12**(1): 33-35.
- Nedunchezhiyan, M., Naskar, S.K. and Byju, G. (2008). Performance of sweet potato (*Ipomoea batatas* (L.) Lam.) varieties under shaded and open field conditions. *Indian J. Agric. Sci.*, **78**(11): 974-977.
- Ochieng, L.A. (2019). Agro-Morphological characterization of sweet potato genotypes grown in different ecological zones in Kenya. *J. Hortic. Plant Res.*, **5**: 1-12.
- Okpara, D.A., Mbah, E.U. and Ojikpong, T.O. (2013). Association and path coefficients analysis of fresh root yield of high and low cyanide cassava (*Manihot esculenta* Crantz) genotypes in the humid tropics. *J. Crop Sci. Biotech.*, **17**(2): 103-109.
- Padma, S.S., Vijay., Kameswari, P.I., Ramana, K.T. and Venkata. (2009). Correlation studies and path analysis in edible cassava germplasm in the tribal zone of Andhra Pradesh. *Indian J. Hort.*, **66**(3): 319-322.
- Pallavi Wani., Ambresh. and Shantappa, T. (2023). Genetic variability, heritability and genetic advance for growth, yield and quality parameters among orange-fleshed sweet potato [*Ipomoea batatas* (L.) Lam.] genotypes. *Biol. Forum-An International Journal.*, **15**(1): 405-411.
- Pallavi Wani., Ambresh., Shantappa, T., Hanchinmani, C.N., Arunkumar, B. and Suvarna, P. (2022). Genetic variability for yield and yield related traits in orange-fleshed sweet potato (*Ipomoea batatas* L.) genotypes. *Int. J. Hortic. Food Sci.*, **4**(1): 183-186.
- Pankaj Singh, B., Chandra, D., Ram, C.N., Verma, S.K, and Singh, S. (2018). Studies on genetic variability, heritability, genetic advance, correlation coefficient and D² analysis in sweet potato (*Ipomoea batatas* L.). *Indian J. Hill Farming.*, **31**(1): 207-213.
- Panse, V.G. (1957). Genetics of quantitative characters in relation to plant breeding. *Indian J. Genet. Plant Breed.*, **17**(2): 318-328.
- Panse, V.G. and Sukhatme, P.V. (1985). Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi, India.
- Parida, A.K., Bera, M.K. and Nandi, S. (1999). Identification of parameters influencing sweet potato tuber yield under late planted rainfed condition. *Environ. Ecol.*, **17**: 971-974.
- Patel, C.J., Patel, N.H., Gami, R.A., Patel, A.K. and Chauhan, R.M. (2013). Assessment of potato (*Solanum tuberosum* L) hybrids-varieties for processing purpose among yield and quality traits. *Trends in Biosci.*, **6**(5): 676-681.

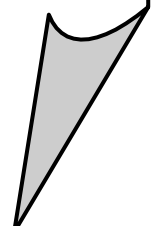
- Perez Tabares, F.M., Perez Talavera, S. and Diaz Esquivel, R.M. (2001). Characterization of clones of sweet potatoes and study of their path coefficients. *Alimentaria.*, **38**(325): 91-93.
- Pushkaran, K., Sukumaran Nair, P. and Gopa Kumar, K. (1976). Analysis of yield and its components in sweet potato. *Agric. Res. J. Kerala.*, **14**: 153-159.
- Pushpalata, T., Agrawal, K. and Tandekar, K. (2011). Studies on orange fleshed sweet potato for yield and quality traits. *Agri. and Biol. Res.*, **27**(1): 20-28.
- Rahajeng, W., Restuono, J., Indriani, F.C. and Purwono, P. (2020). Genetic parameters of agronomic traits in sweet potato accessions. *Biosaintifika: Journal of Biology and Biology Education*, **12**(2): 240-246.
- Rajesh Kumar Jain, B.P. and Ganguli, D.K. (1996). Variability, character association and path analysis in sweet potato. *Tropical tuber crops, problems, prospects and future strategies*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi and Calcutta, pp 142-145.
- Ramachandra, M.K. and Srinivasa, V. (2017). Variability, heritability and genetic advance for quantitative and qualitative traits in potato genotypes under hill zone of Karnataka. *Green Farming.*, **8** (6): 1250-1253.
- Rao, P.V., Dora, D.K., Naskar, S.K. and Jagadev, P.N. (1992). Variability studies in sweet potato. *J. Root Crops.*, **18**(2): 126-127.
- Ratna, D., Setyo, D.U., Kamal, M., Paul, B., Timotiwu. and Siti, N. (2019). Genetic and phenotypic diversity, heritability, and correlation between the quantitative characters on 30 sweet potato germplasms in Lampung, Indonesia. *Biodiversitas*, **20**(2): 380-386.
- Regassa, D. and Basavaraj, N. (2007). Correlation and path analysis in potato (*Solanum tuberosum*). *Potato J.*, **34**(1-2): 57-58.
- Richardson, V.A. (2012). Tuber quality and yield of six sweet potato varieties evaluated during 2012. Gladstone road agricultural centre crop research report.13
- Roy, A.K. and Singh, P.K. (2006). Genetic variability, heritability and genetic advance for yield in potato (*Solanum tuberosum* L.). *Int. J. Plt. Sci.*, **1**(2): 282-285.
- Sahu, G.D., Singh, J. and Mehta, N. (2005). Correlation and path coefficient analysis in sweet potato. *Environ. and Ecol.*, **23**(2): 207-211.
- Saladaga, F.A. (1981). Genetic variance, heritability and correlation for genetic characters of the sweet potato. *Ann. Trop. Res.*, **41**(11): 406.
- Sankari, A., Thamburaj, S. and Kannan, M. (2001). Genetic variability in sweet potato. *J. Root Crops.*, **27**(1): 71-73.
- Sattar, M.A., Sultana, N., Hossain, M.M., Rashid, M.H. and Islam, A.K.M.A. (2007). Genetic variability, correlation and path analysis in potato (*Solanum tuberosum* L.). *Bangladesh J. Plt. Breed. and Genet.*, **20**(1): 33-38.

- Sharavati, M.B., Srinivasa, V., Anusha, R.B. and Shubha, A.S. (2018). Genetic variability studies in Sweet Potato (*Ipomoea batatas* (L.) Lam.) genotypes under Hill Zone of Karnataka, India. *Int. J. Curr. Microbiol. Appl. Sci.*, **7**(9): 850-858.
- Sharma, G.P. (2004). Selection of ideal genotypes from open pollinated seedling population of sweet potato (*Ipomoea batatas* (L.) Lam.). *M.Sc. (Ag.) Thesis*. IGAU, Raipur.
- Shashikanth Evoor Patil, M.P., Madalageri, M.B. and Mulge, R. (2008). Genetic variability, heritability and genetic advance in sweet potato (*Ipomoea batatas* (L.) Lam.). *Environ. Ecol.*, **26**(1A): 322-325.
- Shivanand, B.K., Mukesh, L.C., Jagadeesha, R.C., Vijaykumar, R., Jayappa, J. and Sumangala, K. (2015). Genetic variation and correlations among the physiological growth attributing characters in Ridge gourd (*Luffa acutangula* Roxb.) with reference to yield. *Int. J. Adv. Res.*, **3**(4): 961-971.
- Singh, D., Deo, C., Ram, C.N., Singh, A. and Gautam, D.K. (2015). Variability analysis for yield and yield attributes of sweet potato (*Ipomoea batatas* (L.) Lam.). *Environ. Life Sci.*, **8**(2): 375-376.
- Singh, P. (1998). *Cotton breeding*. Kalyani publishers. New Delhi, pp 191-211.
- Singh, R.K. and Chaudhary, B.D. (1977). Biometrical methods in Quantitative Genetic Analysis. Kalyani Publishers, New Delhi, pp 215-218.
- Sivasubrahmanian, S. and Menon, P.M. (1973). Genotypic and phenotypic variability in rice. *Madras Agric. J.*, **60**: 1093-1096.
- Solankey, S.S., Singh P.K. and Singh, R.K. (2015). Genetic diversity and interrelationship of qualitative and quantitative traits in sweet potato. *Int. J. Veg. Sci.*, **21**(3): 236-248.
- Swarup, B. and Chaughale, D.S. (1962). Studies on genetic variability in sorghum phenotypic variation and its heritability components in important characters towards yield. *Indian J. Genet. Plant Breed.*, **22**: 31-35.
- Teshome, A., Veeranagavathathan, D. and Kannan, M. (2004). Genetic variability and correlation studies in sweet potato. *Madras Agric. J.*, **91**: 420-424.
- Teshome, A., Veeraragavathatham, D. and Kannan, M. (2003). Evaluation of sweet potato (*Ipomoea batatas* (L.) Lam.) clones for high tuber yield, high starch and low sugar to substitute potato in cuisine. *J. Root Crops.*, **29**(1): 41-46.
- Tessema, G.L., Mohammed, A.W. and Abebe, D.T. (2022). Genetic variability studies for tuber yield and yield attributes in Ethiopian released Potato (*Solanum tuberosum* L.) varieties. *Peer J.*, **10**(1):12860.
- Thiyagu, D., Rafii, M.Y., Mahmud, T.M.M., Latif, M.A., Malek, M.A. and Sentoer, G. (2013). Genetic variability of sweet potato (*Ipomoea batatas* Lam.) genotypes selected for vegetable use. *Journal of Food, Agriculture and Environment.*, **11**(2): 340-344.

- Tirkey, P.L., Jitendra Singh Chaurasia, P.C. and Sarnaik, D.A. (2011). Character association and path coefficient studies in sweet potato (*Ipomoea batatas* (L.) Lam.) genotypes. *J. Plant Dev. Sci.*, **3**(1/2): 137-143.
- Tiwari, J.P. (1987). Productivity potential of sweet potato (*Ipomoea botatas* (L.) Lam.). *J. Root Crops.*, **13**: 95-101.
- Tripathi, V., Deo, C., Kumar, A. and Singh, R. (2016). Genetic variability and association studies in sweet potato (*Ipomoea batatas*). *The Bioscan.*, **11**(4): 3203-3206.
- Tsou, C.S., Kam, K.K. and Wang, S.J. (1997). Biochemical studies on sweet potato for better utilization at AVRDC. In: proceeding of International Sweet Potato Workshop. VISCA Philippines, 1987, pp 20-25.
- Tumwegamire, S. (2011). Genetic variation diversity and genotype by environment interactions of nutritional quality traits in East African Sweet potato. Ph.D. Thesis, College of Agricultural and Environmental Sciences, Makerere University, Kampala, Uganda.
- Turner, D.W. (1997). Post-harvest physiology and storage of tropical and subtropical fruits, Mitra, S. K. (Ed.) CAB International, New York, pp 47-77.
- Ummyiah, H.M., Khan, S.H., Jabeen, N., Junaif. and Hussain, N.K. (2013). Inter trait relationship and path analysis in potato. *Prog. Hort.*, **45**(1): 201-205.
- Velmurugan, K., Thamburaj, S. and Kannan, M. (1999). Variability in the open pollinated progenies of sweet potato (*Ipomoea batatas* (L.) Lam) at three stages of harvest. *South Indian Horticulture.*, **47**(1/6): 220-221.
- Verma, A. and Singh, D., (2015). Genetic variability, correlation and sequential path analysis of yield related traits in potato (*Solanum tuberosum* L.) genotypes. *Int. J. Basic Appl. Agric. Res.*, **13**(3): 441-445.
- Vimala, B. and Hariprakash, B. (2011). Variability of characters and dry matter content in the hybrid progenies of sweet potato. *Gene Conserve.*, **10**(39): 65-86.
- Vimala, B. and Lakshmi, K.R. (1990). Heritability estimates in sweet potato. *J. Root Crops.*, ISRC National Symposium., **4**: 35-38.
- Vimala, B. and Lakshmi, K.R. (1999). Evaluation of exotic seed population in sweet potato (*Ipomoea botatas* (L.) Lam.). In *tropical tuber crops in food security and nutrition*, pp 157-162.
- Vimala, B. and Lakshmi, K.R. (1999). Evaluation of exotic seed population in sweet potato (*Ipomoea botatas* (L.) Lam.). In *tropical tuber crops in food security and nutrition*, pp 157-162.
- Vimala, B., Beena Kumari, R. and Bala Nambisan. (2009). Seasonal variations of carotenoids in orange fleshed sweet potato. *15th Triennial ISTRC symposium*. Central Tuber Crop Research Institute, Kerala, India.

- Vimala, B., Sreekanh, A., Hariprakash, B. and Wolfgang, G. (2012). Variation in morphological characters and storage root yield among exotic orange fleshed sweet potato clones and their seedling populations. *J. Root Crops*. 38(1): 155-162.
- Vimala, B., Sreekanth, A., Binu, H. and Wolfgang, G. (2011). Variability in 42 orange fleshed sweet potato hybrids for tuber yield and carotene and dry matter content. *Gene Conserve.*, **40**: 190-200.
- Wilckens, E. R., Vidal, J.T., Hevia, H.F., Gutierrez, C.A.M. and Tapia, V.M. (1993). Exploration of the genetic variation in Chilean sweet potatoes (*Ipomoea batatas* (L.) Lam.) Vegetative morphology. *Agro-Ciencia.*, **9**(2): 87-92.
- Wright, S. (1921). Correlation and causation. *J. Agric. Res.*, **20**: 557-585.
- Yada, B. (2014). Genetic analysis of agronomic traits and resistance to sweet potato weevil and sweet potato virus Disease in a Bi-Parental sweet potato population. Ph.D. Thesis, North Carolina State University, Raleigh, NC, USA.
- Yohannes, G., Getachew, B. and Nigussie D. (2010). Genotypic and phenotypic correlations of root yield and other traits of Orange fleshed Sweet Potatoes [*Ipomoea batatas* (L.) Lam.]. *J. Drylands.*, **3**(2): 208-213.
- Yoshida, T. (1985). Correlation between successive yield tests for agronomic characters in sweet potato. *JPN. J. Breed.*, **35**(2): 204-208.

Plates... 



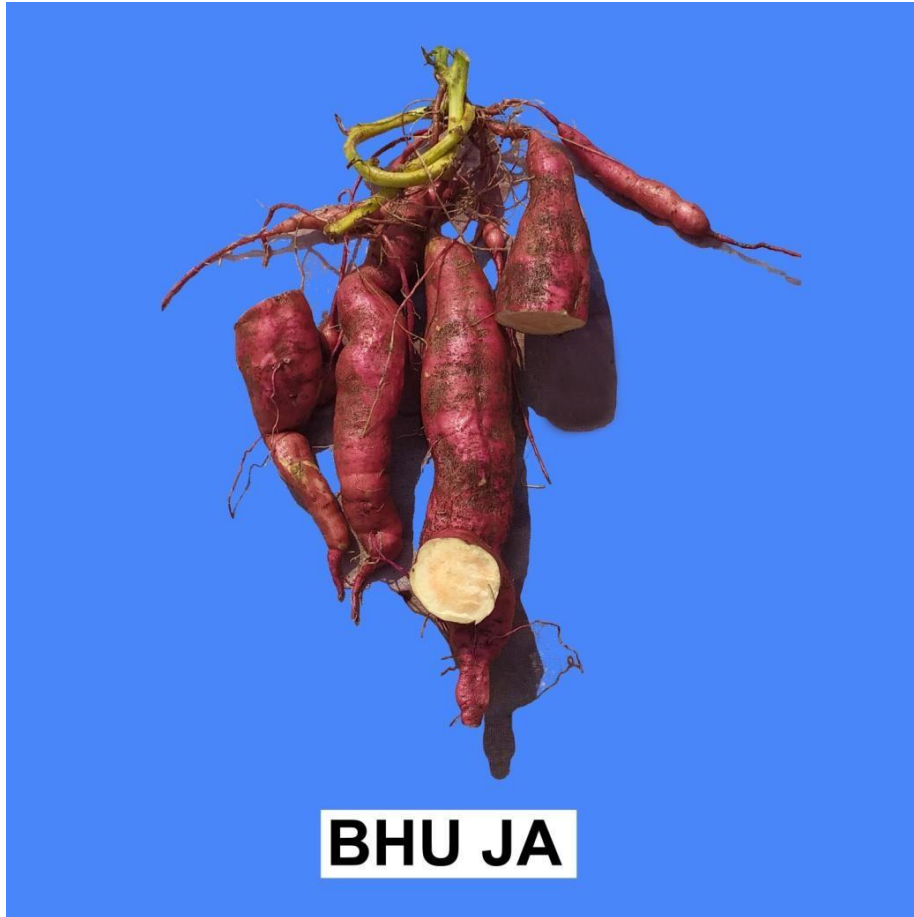


PLATE 1: ORNAGE FLESHED SWEET POTATO TUBERS OF BHU JA AND DERGAON RED GENOTYPES

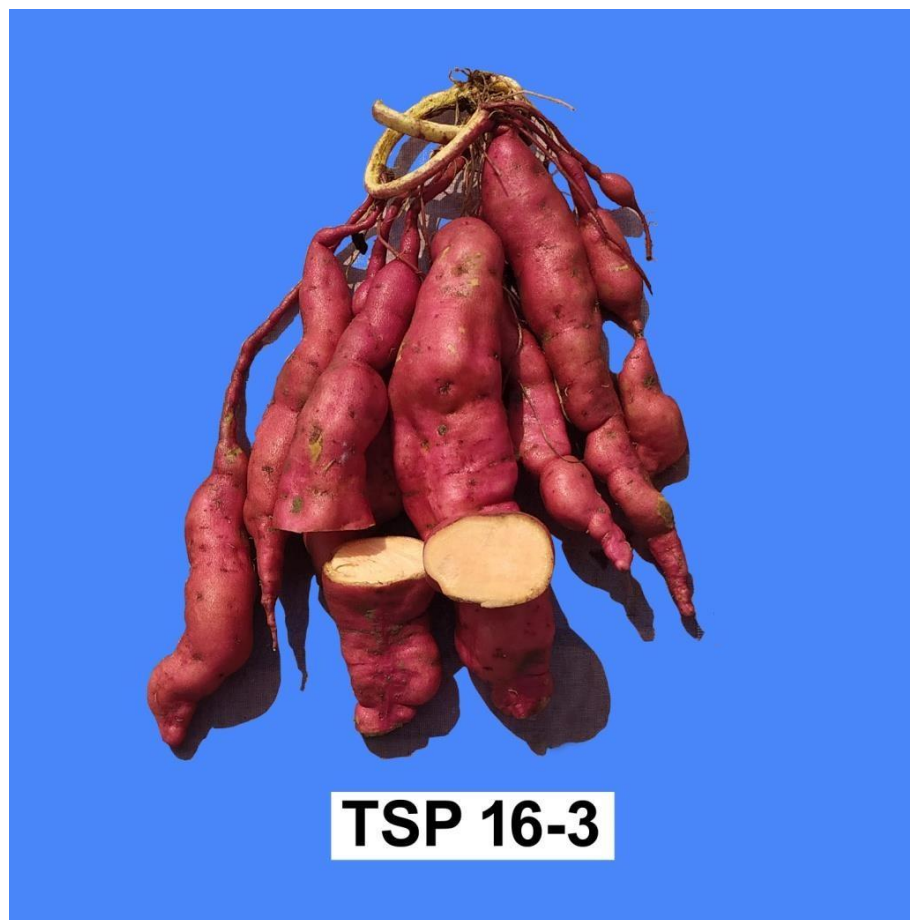


PLATE 2: ORNAGE FLESHED SWEET POTATO TUBERS OF GOURI AND TSP 16-3 GENOTYPES



CIPSAW-2



KAMALA SUNDARI

PLATE 3: ORNAGE FLESHED SWEET POTATO TUBERS OF CIPSAW-2 AND KAMALA SUNDARI GENOTYPES



PLATE 4: ORNAGE FLESHED SWEET POTATO TUBERS OF PSP-1 AND TSP 16-7 GENOTYPES

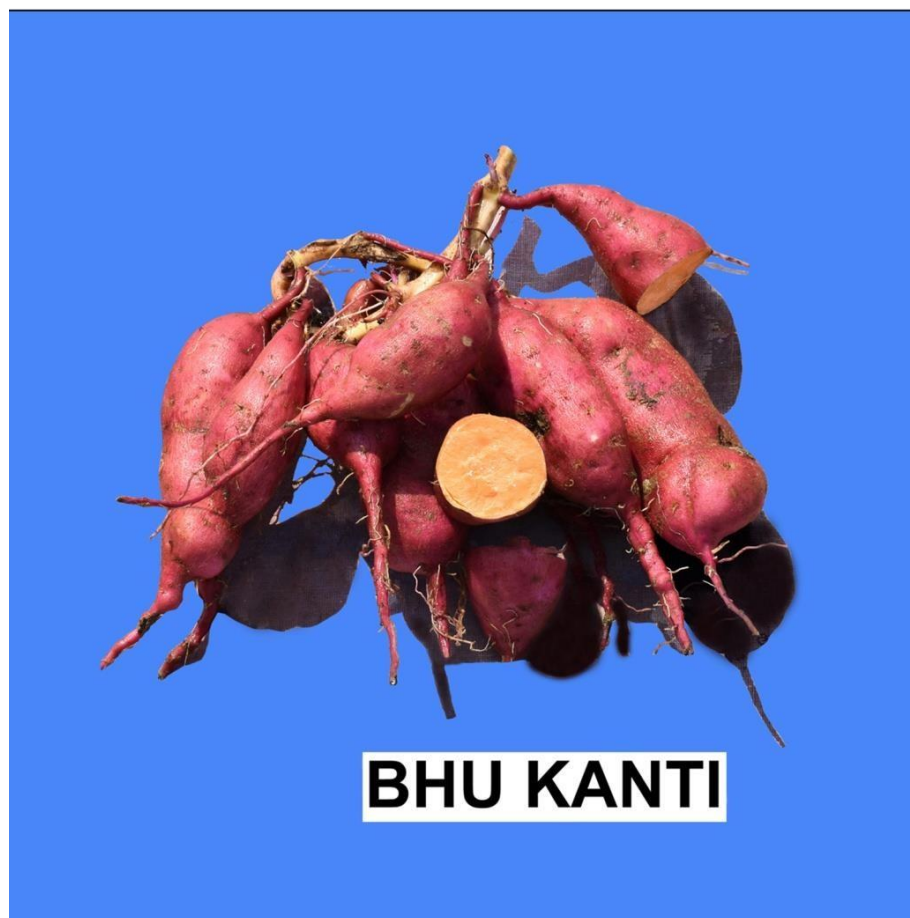
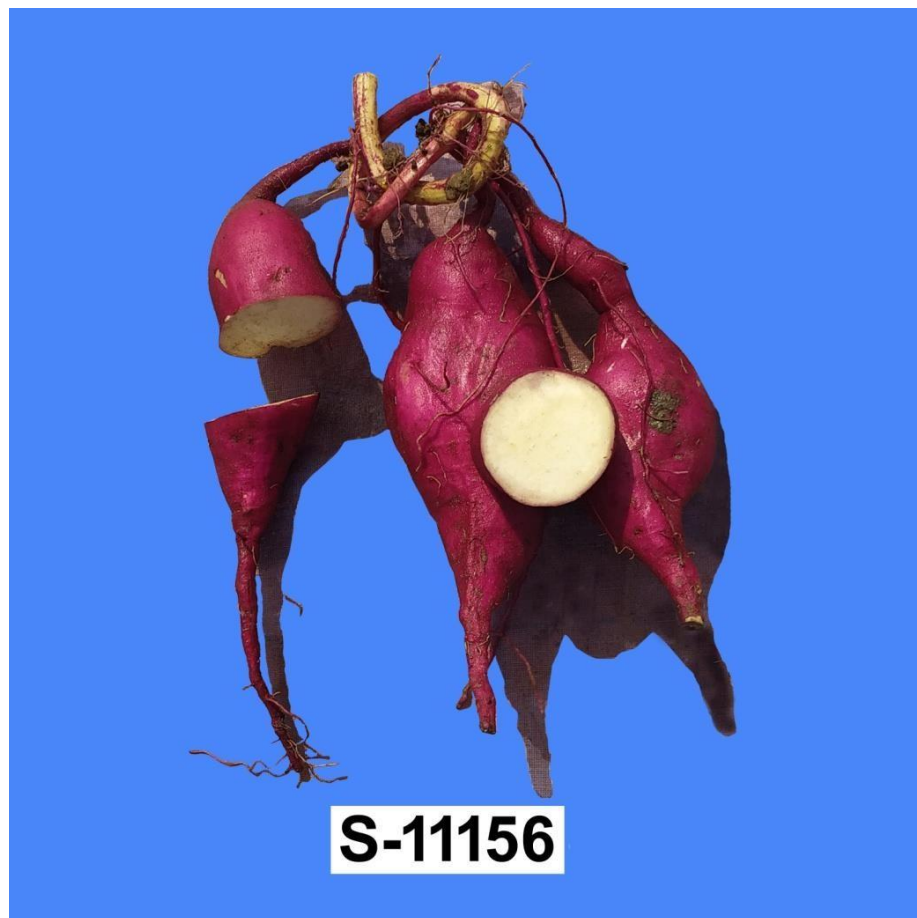


PLATE 5: ORNAGE FLESHED SWEET POTATO TUBERS OF S-11156 AND BHU KANTI GENOTYPES

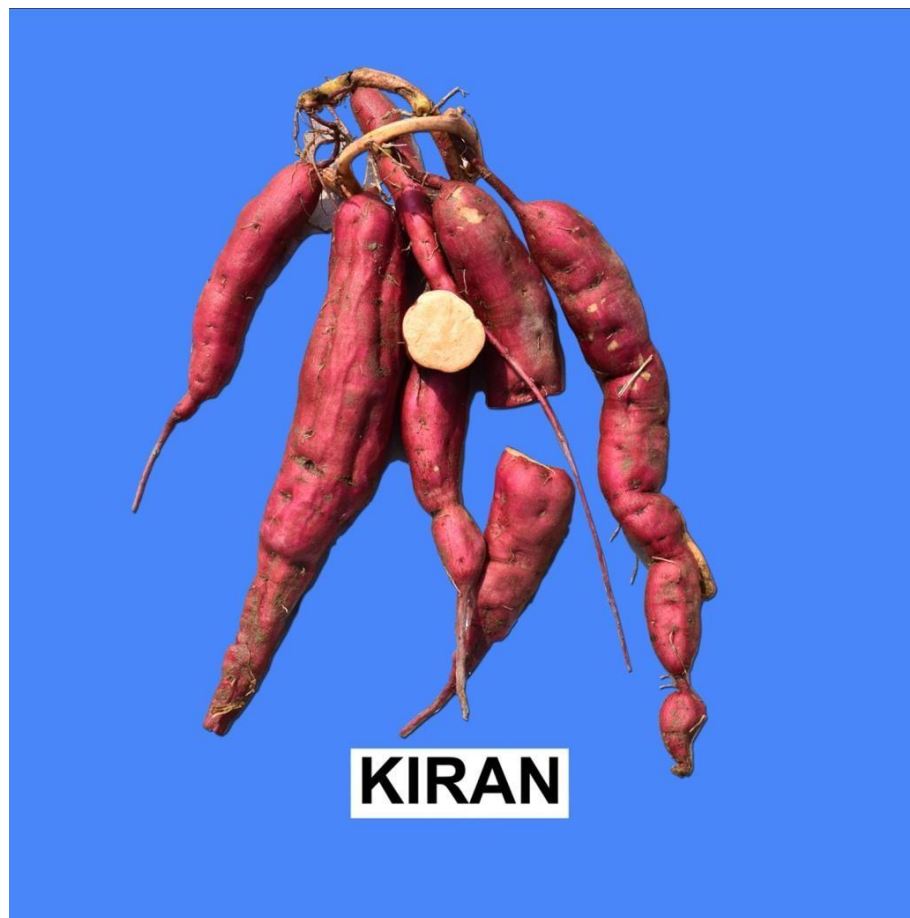


PLATE 6: ORNAGE FLESHED SWEET POTATO TUBERS OF BHU SONA AND KIRAN GENOTYPES

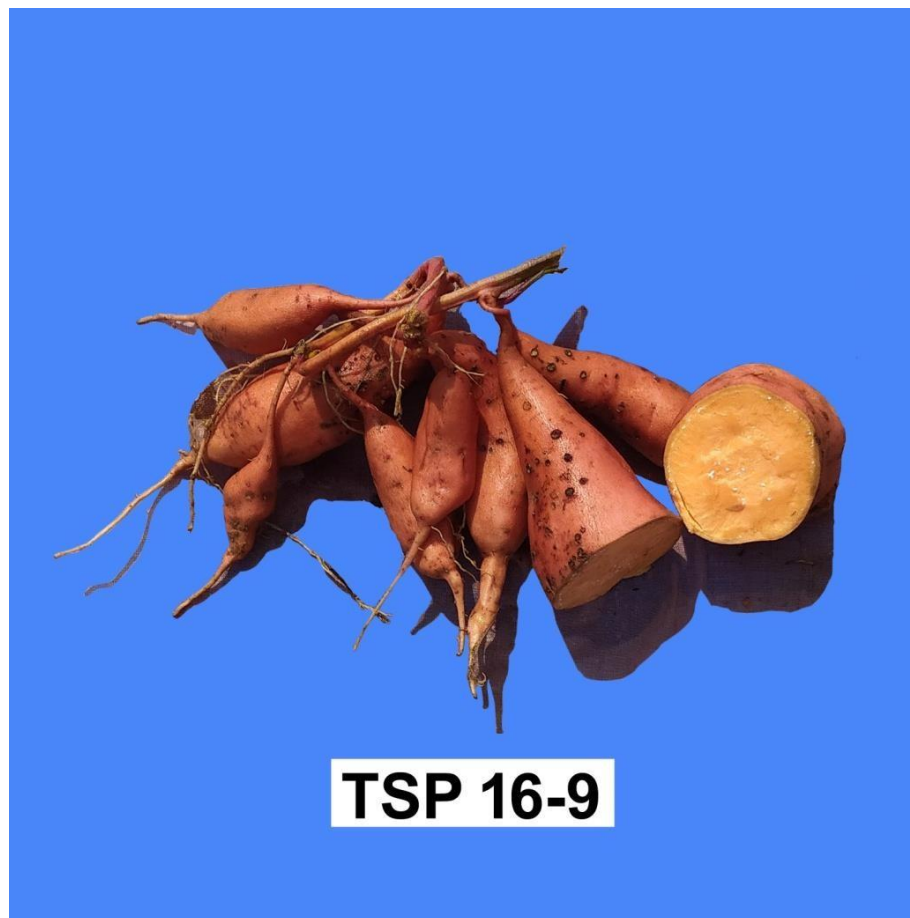
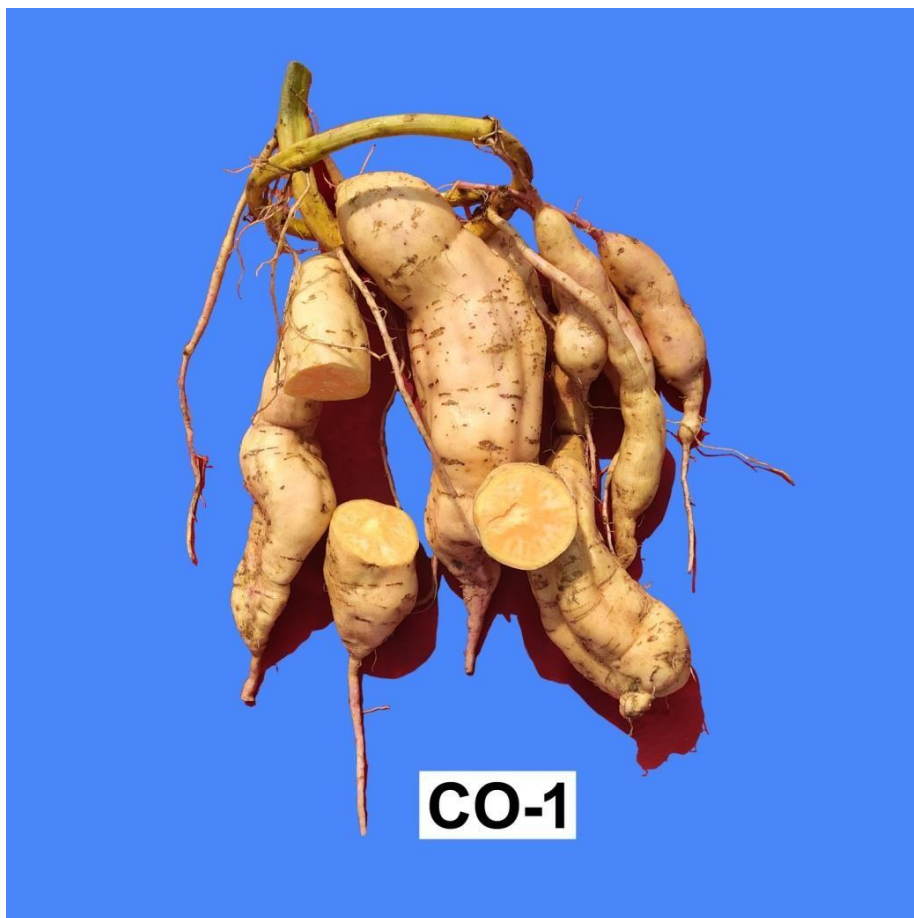
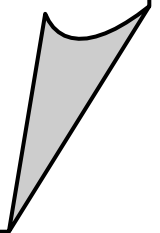


PLATE 7: ORNAGE FLESHED SWEET POTATO TUBERS OF CO-1 AND TSP16-9 GENOTYPES

APPENDICES...&



APPENDIX – I

METEOROLOGICAL DATA FOR THE PERIOD OF EXPERIMENT DURING 2022-2023

Weekly Data	Temperature		RH (%)		RF (mm)	No.of Rainy days	EVP(mm)	WS (kmph)	BSSH (hr)
2022	Max	Min	Morning	Evening					
8 Oct - 14 Oct	29.6	22.4	97	85	94.1	5	1.6	2.3	1.9
15 Oct - 21 Oct	30.9	20.7	97	66	8.2	1	2.1	1.4	8.0
22 Oct - 28 Oct	28.6	19.6	97	71	40.9	2	1.9	2.1	4.4
29 Oct - 4 Nov	30.2	16.9	97	60	0.0	0	1.9	1.2	8.7
5 Nov - 11 Nov	29.8	16.1	98	59	0.0	0	2.0	1.0	8.5
12 Nov - 18 Nov	28.3	14.4	99	57	0.0	0	1.9	1.0	7.9
19 Nov - 25 Nov	28.2	12.3	97	51	0.0	0	1.8	1.3	9.0
26 Nov - 2 Dec	28.4	11.6	99	53	0.0	0	1.8	1.2	9.0
3 Dec - 9 Dec	27.7	11.3	100	53	0.0	0	1.5	1.1	8.3
10 Dec -16 Dec	26.7	11.5	99	58	0.0	0	1.3	0.8	7.5
17 Dec - 23 Dec	26.2	11.8	99	57	0.0	0	1.2	1.0	7.1
24 Dec- 31 Dec	22.1	10.9	100	69	0.0	0	1.1	1.4	2.7
2023									
1 Jan - 7 Jan	23.7	7.9	99	52	0.0	0	1.2	0.9	6.6
8 Jan - 14 Jan	25.2	8.8	98	54	0.0	0	1.4	1.0	7.4
15 Jan -21 Jan	21.4	8.5	99	62	0.0	0	0.7	1.3	3.3
22 Jan - 28 Jan	24.9	8.8	98	53	0.0	0	1.3	1.0	6.6
29 Jan - 4 Feb	27.2	11.5	99	53	0.0	0	1.4	0.9	9.7
5 Feb - 11 Feb	23.3	12.9	99	67	8.5	1	1.4	2.0	0.1
12Feb - 18 Feb	25.1	11.9	98	49	0.2	0	1.7	1.8	5.7
19Feb - 25 Feb	25.0	15.2	97	70	31.8	3	1.6	2.2	1.8