CHARACTERIZATION OF COLOCASIA (*Colocasia esculenta* (L.) Schott) GENOTYPES AVAILABLE IN MON DISTRICT OF NAGALAND

Thesis
submitted to

NAGALAND UNIVERSITY

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of

Doctor of Philosophy

in

Horticulture (Vegetable Science)

by

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2025

Affectionately dedicated

to my parents

(Thanglong Yanlem and Paüwaü Jessuhu)

&

to the Department of Soil & Water

Conservation, Government of Nagaland

DECLARATION

I, **Chumei Yanlem** hereby declare that the subject matter of this thesis is the record of work done by me, that the content of this thesis did not form the basis of the award of any previous degree to me or the best of my knowledge to anybody else and that the thesis had not been submitted by me for any research degree in any other university/institute.

This is being submitted to SAS, Nagaland University for the Doctor of Philosophy in Horticulture (Vegetable Science).

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CERTIFICATE – I

This is to certify that the thesis entitled **"Characterization of Colocasia (*Colocasia esculenta* (L.) Schott) genotypes available in Mon district of Nagaland"** submitted to Nagaland University in partial fulfillment of the requirements for the award of the degree of Doctor of Philosophy in Horticulture (Vegetable Science) is the record of research work carried out by MissChumei Yanlem, Admission No. 195/15**,** RegistrationNo. 835/2019 under my personal supervision and guidance.

The result of the investigation reported in the thesis has not been submitted for any other degree or diploma. The assistance of all kinds received by the student has been duly acknowledged.

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CERTIFICATE – II

VIVA VOCE ON THESIS OF DOCTOR OF PHILOSOPHY IN HORTICULTURE

This is to certify that the thesis entitled **"Characterization of Colocasia (*Colocasia esculenta* (L.) Schott) genotypes available in Mon district of Nagaland"** submitted by Miss CHUMEI YANLEM, Admission No. 195/15**,** RegistrationNo. 835/2019to the NAGALAND UNIVERSITY in partial fulfillment of the requirements for the award of degree of Doctor of Philosophy in Horticulture (Vegetable Science) has been examined by the Advisory Board and External examiner on …………………..

The performance of the student has been found **Satisfactory/Unsatisfactory.**

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2. Prof. Sumati Narayan (External Examiner)	……………………
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Some paths are well taken and worth cherishing, and the completion of my degree is one such. My sincere gratitude and appreciation to all who have been a part of my journey thus far! God Bless us all.

Date:

Place: (Chumei Yanlem)

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVIATIONS

ANOVA	: Analysis of Variance
@	: at the rate
CD	: Critical Difference
Cm	: centimeter
Df	: Degree of freedom
°C	: Degree Celsius
E	: East
et al.	: Et alilbi and others
FYM	: Farm Yard Manure
GCV	: Genotypic Coefficient of Variation
G	: gram
Ha	: Hectare
Kg	: Kilogram
MSS	: Mean Sum of Square
Max.	: Maximum
Min.	: Minimum
m	: Meter
NPK	: Nitrogen Phosphorous Potassium
/	: Per
%	: Percent
PCV	: Phenotypic Coefficient of Variation
RBD	: Randomized Block Design
SAS	: School of Agricultural Sciences
SS	: Sum of Square
t	: tonnes
viz.	: namely
Vit. C	: Vitamin C

ABSTRACT

The present investigation entitled "Characterization of Colocasia (*Colocasia esculenta* (L) Schott) genotypes available in Mon district of Nagaland" has been conducted at research cum instructional farm at Schoolof Agricultural Sciences, Medziphema, Nagaland University during the year 2017 & 2018. The experiment was conducted using a Randomized Block Design (RBD) with three replications and eighteen genotypes. The genotypes were collected from different regions of Mon district of Nagaland to estimate morphological parameters, growth, yield and quality parameters along with coefficient of variation (PCV, GCV), correlation coefficient, path analysis and storage life. For every character, the mean sum of squares resulting from genotypes was extremely significant, according to the analysis of variance. There is a significant amount of diversity in the material tested for the improvement of different qualities, according to the significant means sum of squares due to yield and attributing characters. G-5 had the greatest amount of corms per plant (2.42). G-16 had the most cormels per plant and the largest weight of cormels per plant (g) (11.26 & 363.89g). G-1 had maximum corm weight (g), yield per plot (kg), and yield per ha (q) (430.94g, 12.94kg, and 241.50 q). The highest heritability and high genetic advancement were recorded by traits such as plant height, number of leaves, number of suckers per plant, number of cormels per plant, weight of corm per plant, weight of cormels per plant, yield per plot, and yield per ha, indicating the significance of these traits in yield selection.Correlation studies reveals that LAI, number of suckers per plant, weight of cormels per plant, starch content have the highest significant positive correlation with yield both at genotypic and phenotypic level. Path coefficient analysis shows that the weight of corm per plant had the greatest positive direct effect on yield, followed by the weight of cormels per plant. The weight of cormels per plant had the greatest positive indirect effect. It can be used in breeding to exploit the heterotic expression for yield and its component characters in colocasia under Nagaland conditions. G-1 also showed the best storage life based on physiological loss in weight, sprouting index and rotting index.

Keywords: Colocasia, morphology, growth, yield, coefficient of variation (PCV, GCV), correlation, path analysis, storage life

(CHUMEI YANLEM)

CHAPTER I
INTRODUCTION

INTRODUCTION

Sustainable agriculture is the need of the hour as the world today faces threats of climate change through human activities which also include agricultural activities and intensive farming practices. Therefore, there is a need to introduce crops which give good yields, good income to farmers under low farm-inputs and less negative impact upon the environment. Since colocasia has been known to be in cultivation for thousands of years, this has been so because of its adaptability and sustainability. Colocasia is known to help in soil health improvement through some species of colocasia which has nitrogen fixation ability while having symbiotic relationships with nitrogen–fixing bacteria *Azospirillum*. (Jolly *et al.,* 2010). It is also known to help in erosion control especially in the slopes and places of heavy rainfall, due to its extensive root system which binds the soil and its dense foliage which allows less exposure of soil to the weather elements and rain. Colocasia is also known for carbon sequestration, as its biomass help to sequester carbon dioxide from the atmosphere. It thrives in wetlands and marshy places where it aids to filter pollutants from water bodies. It is a crop that requires less inputs like fertilizers and pesticides, which reduces environmental soil and water hazards, hence Colocasia (*Colocasia esculenta*) is known for its contribution towards sustainable agriculture, besides its nutritional and culinary value in the households.

The tuber crops such as taro, potatoes, yams and sweet potatoes are rich in nutrients, such as essential nutrients, carbohydrates, vitamins and minerals. Many tubers are high in dietary fiber and rich in antioxidants. Tuber crops can be grown in a variety of climates, they require less input but they are often high value crops that have a wide range of uses, which creates great market opportunities. The major challenge which lies ahead is to conserve the landrace which encompasses the rich biodiversity and the cultural heritage as they are diminishing due to various stresses both environmental and economical reasons.

Colocasia (*Colocasia esculenta* (L.) Schott) belongs to the family Araceae and is one of the oldest crops with enlarged roots eaten as vegetables. Colocasia is also known by the name taro, it is also known as Elephant's ears. It is a perennial crop that is erect, herbaceous, monocotyledonous. Colocasia and xanthosoma are known as aroids and are considered to have originated in the Indo Malayan region, perhaps in Eastern India (Pena, 1970). It is known to be an ancient crop that originated in the Indo-Malayan region, probably in eastern India and Bangladesh (Yen and Wheeler, 1968). It is believed that the origin of domesticated taro is from wild type *Colocasiaesculenta*.var. *aquatilis* either in North East India or South East Asia (Matthews, 1991). Two types of colocasia eddoe (*Colocasia esculenta* var. *antiquorum*) and dasheen (*Colocasia esculenta* var. *esculenta*) are commonly cultivated throughout the country. The eddoe type is commonly called arvi and dasheen type is calledbunda. The name *Colocasia* comes from the Egyptian word *coleus* or *kulkas* (Plucknett, 1970).

Africa ranks first in area and production of Colocasia, followed by Asia. It is crop of tropical and sub tropical regions and requires a warm humid climate, can be grown upto an elevation of 1500 m elevation with well distributed rainfall ofabout 1000 mm during growth period. In Northeast India the species of colocasia found are *C. affinis, C. esculenta, C. fallax, C. gigantea, C. lihengiae etc*. among which *C. esculenta* is edible. Taro is one of the few edible species in the genus Colocasia. Cultivated types are mostly diploid (2n=2x=28) although some triploids are found (2n=2x=42) (Singh *et al.,* 2008).Thecorm and cormels are the major economic part of the crop. Depending on the cultivars and culture, the leaves, blossoms and petioles are occasionally utilized for food (Fred *et al.* 2011). Tubers are rich in starch, protein and minerals while leaves contain pro vitamins A and C (Chopra*et al.,*1956). Acridity is due to the presence of calcium oxalate crystals in the corms, cormels and leaves. The corm, the underground stem is starchy, compact and thick. A good quality of colocasia is without any raphides, fibreless and soft like butter after cooking. In Nagaland corms and cormels are generally consumed after boiling and thepetioles and tender leaves are commonly used as vegetables. Anishi is a popular fermented food product prepared from colocasia leaves, it is a popular delicacy of Nagaland, particularly of the Ao Naga tribe.

Colocasia is also used in preparation of animal feed and the starch for industrial use. Bothtaro and sweet potato are consumed in three ways *viz,* human food, animal feed and in the production of alcohol and starch (Yared and Tewodros, 2014). After human consumption, leftover colocasia cormels and leaves are fed to household livestocks, hence there is zero wastage. It makes a good substitute for potato and is useful for making chips. The flour produced from the corm is similar to potato flour and is used to make soup, biscuits, bread, beverages and puddings (Moy and Nip, 1983). It is also used in folklore system of medicine in different tribal areas of the world (Nadkarni, 1927). Hot tubers are locally applied to painful parts in rheumatism. Colocasia is usually planted in the month of March-April and is harvested by November -December. It has the ability to grow under diverse agro climatic conditions, including its ability to survive and produce corm under salty conditions (Lloyd*et al.,* 2021), to some extent it is drought tolerant and is well adapted to wet and waterlogged soil (Yamaguchi 1983). Multiple vegetative parts of the taro plants can be used as planting materials, including cormel, sucker and stolon (Setyawan*et al.,* 2021). Harvesting is done by digging out of the soil, removing the roots, corms and detaching the cormels from the mother corm. The harvested corms are laid in the sun to dry and piled in the shade and stored, primarily for food for the lean period as well as for planting material for the next season.

Mon district of Nagaland situated in northeastern part of India also famouslyknown as the “Land of Ahngs” was recognised by the then Planning Commission of India as one of the most backward districts of the Indian subcontinent. It is home to the Konyak Naga tribe, it shares its borders with Myanmar in the east, Assam in west, Arunachal Pradesh in the north and Tuensang region in the south. More than 70% of the population depends on agriculture for its livelihood and jhum (shifting) cultivation is the principal agricultural practice. The district is situated in the Indo-Burma region, which is the centre of origin of many plant species (Thirugnanavel*et al*., 2013). The northeast region is intense in colocasia diversity for both improved and uninhabited species, particularly in jhum fields, homestead backyards, nearby aquatic bodies, river banks, forests also in the jungles (Thirugnanavel *et al.*, 2015). Northeast India occupies 7.7% of total geographic area in India which accounts for 50% of the biodiversity of the country (Deka *et al*., 2012). The status of colocasia is of significant importance in Mon, Nagaland. It is infact the stable vegetable consumed by all the Konyak households in all the villages, next to rice. The tender leaves, petioles and runners are all consumed as vegetables and because of its excellent storage quality it is considered as ideal cropto alleviate the lean period of vegetable supply. The jhum fields serve as a reservoir of colocasia variability and several land races have been grown in the same field, The Konyak farmers are jhumias by profession, this practice is an old system of farming that has passed on from generations. With the indigenous traditional knowledge that has been passed down, the farmers gained experience relying on the deep understanding of local environmental conditions, soil types and plant characteristics. They have improvised traditional farming by adopting modern agriculture through various government schemes and programmes upto some extend, but the majority still remains dependent on traditional jhum cultivation, where colocasia is grown as one of the mixed cropping crops along with paddy, maize, cucurbits, chilli, ginger etc. in a jhum field.

Mon is blessed with the agro-climatic condition which is suitable for all type of vegetable crops grown in the region, as it falls under one of the biodiversity hotspots in the world. Though there is a high indication of genetic variability in the region, however there is no attention that has been given for conservation of colocasia landraces. Colocasia is one of the main crops grown in this region and best suited in this area. In almost all the Konyak households, it is a crop having both cultural and agricultural importance. It is consumed by both human as well as animal with zero wastage. However the potential of colocasia is yet to be put under research and development. Genotypes and nutrition play an important role which regulates growth and productivity in a cultivar. Varietal performance for cultivation of these crops is more governed by quality characteristics rather than yield. Several genotypes are existing in different portions of Mon district and in Nagaland wide variation in height and growing habit exist among the genotypes. Cultivation of crops like colocasia will not only increase the food production but also serve as balanced nutrition to the deprived sectionof the region. Taking into account the various facts and aspects ofgenotypic suitability and yield, it was felt necessary to study and undertake an experiment on **"Characterization of Colocasia (*Colocasia esculenta* (L.) Schott) genotypes available in Mon district of Nagaland''**. The current research on the characterization studies in colocasia has been taken up with eighteen genotypes collected from different altitudinal ranges of Mon. Hence, a comparative study on the colocasia genotypes was taken up with the following objectives:

1. To study the physico-chemical characters ofcolocasia genotypes.
2. To study the biometrical analysis in parameters of colocasia genotypes.
3. To study storage life of colocasia genotypes.

CHAPTER II
REVIEW OF LITERATURE

REVIEW OF LITERATURE

The work done on various aspect of the present study entitled **"Characterization of Colocasia (*Colocasia esculenta* (L.) Schott) genotypes available in Mon district of Nagaland"** has been reviewed in this chapter under following subheads:

2.1Collection and conservation of colocasia germplasms

Janseens (2001) reported that genera *Colocasia* and *Alocasia* have the primary centre of origin from the Indian subcontinent whereas the genus *Cyrtosperma* originated from Indonesia.

Edison *et al.* (2003) procured 424 indigenous collections conserved at CTCRI, Trivandrum representing all the genetic stocks from Indian subcontinent where the corms and cormels of different collected germplasms were raised for *ex-situ* conservation in the field.

Kreike *et al*. (2004) described that Taro can be divided into two botanical varieties characterised by their corm shape, *viz.*, var. *esculenta* (dasheen type) and var. *antiquorum* (eddoe type). Theystudied the Ploidy levels of 255 cultivars through flow cytometry and concluded that the accessions analyzed from Asia were diploids and triploids, while the accessions from the Pacific were diploids.

Okpul*et al*. (2004) obtained 279 cultivated taro accessions from nine provinces of Papua New Guinea and these were characterized based on 18 major agro-morphological descriptors.

Singh *et al*. (2008) collected 859 taro germplasms from 15 provinces of Papua New Guinea which were established on the data generated from agro-morphological descriptors and DNA fingerprinting using seven SSR primers.

Talwana *et al.* (2009) described that *Colocasia esculentum* originated in the Indo-Malaysian region, particularly in eastern India and Bangladesh from where it spread eastwards into southern Asia and the Pacific Islands and westwards to Egypt and the Eastern Mediterranean.

Ginwal and Mittal (2010) described that DNA yield/ concentrations of approximately 200-500 µg/ 100 mg of *Acorus calamus* and the purity ratio (260/280) of around 1.7-2.0 were optimum for carrying out RAPD and SSR analysis.

Beyene (2013) collected 100 germplasms of Taro from different regions of Ethiopia and was laid in 10 x10 simple lattice design with two replications to characterize the germplasms morpho-agronomically.

Asomani *et al.* (2017) studied and reported on the germplasm and ethnobotanical information of taro collected from 19 districts in Ashanti, eastern and western regions of Ghana. Sixty taro accessions were collected whereby 34 were from fields, 23 were from home gardens, 2 were from roadside and 1 from the wild.

Andreas *et al.* (2018) indicated that distinct gene pool existed in all the regions where taro was naturally distributed in the Indian subcontinent, China, Southeast Asia and in Oceania. The Centre for pacific Crops and Trees (CePaCT) was known to conserve *in-vitro* close to 70% of the taro genetic resources held ex-situ and therefore considered the world centre for taro genetic resources.

Thirugnanavel *et al.* (2022) reported that the north-east India being rich in genetic diversity of colocasia both cultivated and wild species particularly in jhum fields, homestead gardens, near water bodies, river banks, forests and road sides. Wide range of variability was observed in corm and cormel characters, yield and quality characters. In recent past, however the genetic diversity of colocasia was under threat due to urbanization, climate change, introduction of new crops, pest and diseases which resulted in genetic erosion. Therefore, conservation of vast gene pool was necessary in this region.

Tadik *et al*. (2023) conducted an experiment at experimental farm of SAS, NU Medziphema, Nagaland during kharif season, by collection of fourteen genotypes from three states of north east. To select the traits that would be used as selection criteria in breeding programmes.

2.2 Growth and development of colocasia genotypes (Morphological characters)

Dwivedi and Sen (2001) conducted an experiment in West Bengal to study the growth characters, yield attributes and cormel yield of 15 improved local taro cultivars namely BCC-1, BCC-2, BCC-4, BCC-8, BCC-9, BCC-10, BCC-11, BCC-13, BCC-16, BCC-17, BCC-18, BCC-19, BCC-20, BCC-21. Cultivar BCC-13 was found superior to all other cultivars in terms of the length and girth of the main sucker. However, the number of side suckers and petioles per plant were greatest in BCC-11.

Mitra *et al.* (2007) studied on morphological characters, yield attributes, nutritional status and isoenzyme profiles of elite genotypes of taro in the University Horticultural Research station and observed significant differences in the plant growth characters like length, length and breadth of leaf lamina among the taro genotypes. The average length and girth of main sucker ranged between 66.3-84.7 cm and 12.1-18.1 cm respectively. Similarly, significant variations in yield and yield attributing characters like average weight, length and girth of cormel, number and weight of cormel/plant were recorded among the different genotypes. Average yield varied from 10.1-14.9 t/ha. High yield potential was observed in BCC-16, BCC-24, BCC-32 and BCC-1. The genotypes with high length: breadth ratio of leaf lamina were generally showed resistance to blight disease. Dry matter and starch (dry weight basis) content of the tubers varied within the cultivars and ranged between 23-2-29.2% and 29.5-45.7% respectively.

Mwenye *et al*. (2010) carried out a study in which Cocoyam accessions of Malawi were characterised using ethno-botany and morphological characters. Thirty above ground qualitative characters were evaluated for morphological characterization, pre-sprouted corms were planted at Chitedze Research Station in a randomised complete block design (RCBD), with three replications of five plants each. The planting distance was 0.9m between rows and 0.9m between plants and the parameters were evaluated between 3-6 months after planting. It was observed that variation within the species was moderate: however, it was high in *Colocasia* species compared to *Xanthosoma*.

Dimbeshwar *et al*. (2014) carried out a study throughout the Nazira subdivision, Assam on the diversity of Aroids (Araceae). A total of 26 species belonging to 17 genera were collected, out of which 8 species (32%) were edible and 18 species were ornamental (68%) and 14 terrestrial (54%), 9 were climbers (35%), 2 were marshy land (8%) and 1 was aquatic (4%).

Chinelo *et al*. (2015) carried out a comparative morphological study of five varieties of *Colocasia esculenta* L. Schott in Anambra state Nigeria and came up with the result that the leaf length ranged from 35.6 ±7.70 cm to 49.9±3.55 cm, highest petiole length was 63.3 ±3.83 cm whereas the least was 26.67 ±2.20 cm. The corm length ranged from 4.10± 0.10 cm to 8.60 ±0.35 cm, while the cormel length ranged from 3.70 ±0.96 cm to 7.03± 0.36 cm.

Boampong *et al.* (2018) collected 18 accessions. These consisted of exotic ones from Samoa, Malaysia, Indonesia while the local ones were obtained from different parts of Ghana.data were collected for sixteen qualitative and thirteen quantitative traits. Significant differences p ($\leq$ 0.05) were observed, indicating higher degree of variability in the accessions, desirable qualities such as earliness and yield were ascertained for selection.

Angami *et al*. (2019) carried out a study on varietal evaluation in taro for growth, yield and quality attributes. In the study, replicates experiment and morphological and chemical analysis was done. Significant differences were recorded for all characteristics studies.

Khatemenla *et al.* (2019) reported that morphological characters like plant height, plant span, leaf area index, number of suckers, number of inflorescence, corm length, corm diameter, corm weight, number of cormels, cormels diameter and yield per plant contributed maximum to the variation among the cultivars.

Tewodros *etal*. (2021) carried out field experiment in south western Ethiopia/ where three improved and one local taro variety were used in the trail laid out in a randomized complete block design (RCBD). The data were collected and analyzed using SAS 9.2 version statistical software. The study findings revealed that variety had a significant ($p \leq 0.01$) impact on all of the variables considered.

Ramdeen *et al*. (2023) conducted a morphological a morphological study in Assam to compare fifteen varieties of taro. The aim of this study was to provide plant taxo

Sangeeta *et al.*(2023) observed that significantly wide variation was shown among twenty taro genotypes for growth parameters. Regarding plant height, the highest plant height significantly at 120 DAP of 174.97 cm was noticed in genotype Piriyapatlana Local followed by Mudigere Local (171.80 cm) whereas Nymati Local (132.77 cm) was the lowest. And other parameters of petiole length, number of leaves per plant, leaf length, leaf area upto 120 DAP were observed with significant variation. This variation in growth variation, varietal characteristics and environmental effects.

2.3 Physico-chemical characters of colocasia

Sen *et al*.(2003) carried out an experiment in West Bengal wherein they evaluated the nutrient composition of the cormels of 6 cultivars namely C-62, Topi, NDC-2, Telia, Nadia local and Jhankri at different stages of tuber development (100,120,140,160 and 180 days after planting). The contents of dry matter, starch, crude protein and minerals varied considerably among cultivars. The changes in nutrient composition, except crude protein, were observed during the different stages of tuber development. Topi and Jhankri were nutritionally superior to the other cultivars. Tubers harvested at 140 days after planting showed good nutrient content with respect to carbohydrates and proteins.

Jirarat *et al*. (2006) investigated on the chemical and physical properties of taro (*Colocasia esculenta* L. Schott) flour extracted from different sized taro corms cultivated in 4 different regions of Thailand. When considering chemical composition of taro cultivating within the same area, the medium sized taro corm from each cultivating area comprised less carbohydrate and more protein content. An exception was found in Saraburi taro which showed no significant difference in carbohydrate and protein contents in flours from taro of different corm sizes. However, there was no correlation between taro corm size and carbohydrate content or other chemical compositions. Moreover, calcium oxalate contents in taro flour from taro of different sizes were not significantly different ($p>0.05$).

Davies *et al.* (2008) studied on the physicochemical and functional properties of starch from cocoyam and ten varieties of cassava to unravel their potential in industrial application. The properties of starch varied significantly with crop and among varieties. The cocoyam starch gave lower value of amylose content and paste clarity but higher phosphorus content. Cocoyam starch exhibited lowered swelling power and solubility than cassava starches.

Awokoya *et al*. (2012) analysed on the starches of red cocoyam *(Colocasia esculenta*) and white cocoyam (*Colocasia antiquorium*) for their proximate compositions, physicochemical properties and pasting properties. Ash, moisture and amylase contents of red cocoyam were found to be higher than that of white cocoyam and their protein contents were significantly similar.

Maninder *et al.* (2013) investigated on the physicochemical and pasting properties of taro flour and compared with flours from other botanical sources. Proximate composition, colour parameters, water and oil absorption, foaming characteristics and pasting properties of flour were related to each other. Taro flour was significantly different from other flours in exhibiting highest carbohydrate, water absorption, and lower protein, foaming capacity and setback viscosity.

Emmanuel *et al.* (2014) investigated the effect of peeling and cormels weight on physicochemical and rheological properties of taro flour. The cormels were divided by the weight into four classes; size, 170g, 170<size < 214g, 214<size<284g and size>284g. The study revealed that taro flours are mainly made of dietary fibers. It was observed that peeling methods and weight of taro cormels influenced on some physicochemical composition of flour.

Fan –Kui *et al.* (2014) extracted starch from the corms of taro cultivated in Hunan, China and its physicochemical properties were determined and compared with those of potato and sweet potato starches. The surface average granular diameter ranged from 1.3to 2.2 µm. Amylose content in taro starch was 8.4 ±0.2% determined by dual wavelength colorimetry.

Karina *et al*. (2016) determined the physicochemical and nutritional characteristics of *Colocasia antiquorum* starch cultivated in Oaxaca, Mexico. The chemical composition analysis showed levels of moisture, ash, protein, fat, fibre in a dry base of 10. 29, 0.18, 2.0, 0.05 and 0.01respectively, as well as amylase and amylopectin contents of 13.05 and 86.95%, respectively. The nutritional characterisation of *Colocasia antiquorum* starch amounted to 97.88% of total starch while available starch and resistant starch were 93.47% and 3.705 %, respectively.

Kritika *et al.* (2019) gave a detailed assessment of phytochemical compounds present in various extracts of the leaves. The study revealed that colocasia leaves are rich sources of micronutrients, however the presence of oxalates can prohibit proper utilization of these nutrients. Various food processing strategies like soaking, cooking, can significantly reduce the antinutritional content and make these nutrients available for utilization.

Manisha *et al.* (2021) conducted a study on the physical attributes as well as the biochemical components of taro such as L-ascorbic acid, phenol content, dry matter, moisture, starch, titratable acidity, total sugar and reducing sugar .The result of the study revealed that the cultivar TTR-17-19 showed better qualitative attributes on post-harvest analysis. It had higher total soluble solids (5.333 ^{0}Brix), starch (35.713 %), reducing sugar (3.357 %) and total sugar (5.947 %) as compared to other cultivars that were studied.

Khush *et al*. (2023) reviewed in their study that *Colocasia esculenta* is a magnificent source of fiber and starch , which was responsible for a number of health benefits, such as for improved blood sugar levels, for better skin care, for reducing obesity. *Colocasia esculenta* also contained a variety of antioxidants and polyphenols, Leaves have been reported to be calorie deficient, rich in proteins, micronutrients , dietary fiber and carbohydrates which enhanced the metabolism of digestive system and abundant presence of tannins and oxalates.

2.4 Variability of colocasia

Cheema *et al*. (2007) studied on genetic variability in genotypes collected from different parts of North India. PA-7, PA-5, PA-4, PA-11, PA-15 were comparatively high yielding. The maximum corm weight, corm length, corm girth and starch were observed in Pa-20 while Pa-21 recorded the highest dry matter and lowest oxalate content. Total yield per plant was positively and significantly correlated with number of corms and cormels per plant, oxalate and protein content, and corm length had direct and positive effects on total yields per plant.

Juri *et al*. (2013) collected twenty locally grown taro from different parts of Nagaland and their morphological and chemical analysis were done. The different parameters analyzed include corm length, corm diameter, specific gravity, number of cormels, starch, calcium oxalate, moisture, dry matter, energy, nitrogen (N), phosphorus(P), potassium(K), calcium(Ca), magnesium(Mg) and sulphur(S) contents. Wide variability in nutritional and other quality parameters among the different taro cultivars was recorded. There was strong positive correlation ($P<0.05$) between corm length and specific gravity: calcium oxalate and moisture content. Among the 20 cultivars Nalon, Toongphak, Tanchong Shg, Angphak and Toa Boi were found superior to others with respect to yield attributes, nutritional and other quality parameters based on an overall rank sum index (ORSI).

Pratibha *et al*. (2013) conducted an experiment in the Department of Food Science and Technology, University of Agriculture and Technology Kumarganj. Corms of six taro varieties (NDB-2, NDB-3, NDB-9, NDB-14, EC-20, NDB-21) were converted into flour and analyzed for some physicochemical properties. In general, a wide variation was observed in the chemical compositions of the flour samples analysed. On a dry weight basis, crude protein ranges between 9.30-10.90%, available carbohydrate 71.92-73.05%, crude fibre

1.00-1.69%: ash 5.78-6.65% and crude fat 0.72-0.86%. The variety NDB-2 recorded highest amount of total sugars(6.33%) and it also contained lowest level of oxalic acid and was found suitable for preparation of chips.

Tewodros (2013) tested one hundred accessions of taro at Jimma Agricultural Research Centre during the year 2011 growing season by using 10 x10 simple lattice design with two replications. The objectives of the study were to assess the nature and extent of diversity within collected accessions based on key morphological descriptors and evaluate the accessions based on yield and yield related traits. Data on 17 qualitative and 13 quantitative traits were measured. The analysis of variance for quantitative traits showed that number of active leaves/plant, petiole length and maximum horizontal distance highly significance differences exists for majority of characters studied and also path coefficient analysis at genotypic level showed that there are a number of characters exerting a maximum direct positive effect on fresh tuber yield suggesting that these characters are good contribution to the fresh root yield in taro.

Vinutha *et al*. (2015) carried out a study to morphologically characterise 25 taro accessions collected from different North Eastern states of India using 27 above ground characters based on a combination of National Bureau of Plant Genetic Resources (NBPGR)/International Plant Genetic Resources Institute (IPGRI) descriptors. The study revealed that a high level of diversity existed and coefficient of variation was found to be higher for tillering (51.91) and plant size (54.04) which was useful for the adaptability of the plant.

Ankit *et al*. (2017) studied 18 genotypes of taro at Vegetable Research centre, Pantnagar to evaluate most promising and high yielding genotypes. The extend of genetic variability, heritability and genetic advance in respect to sixteen different characters regarding growth, yield and quality were studied. There were high phenotypic and genotypic coefficients of variation recorded for number of cormels per plant, weight of cormels per plant, weight of corms per plant , tuber yield per plant .

Thejazhanuo *et al.* (2017) conducted an experiment where characterization of taro from eleven districts of Nagaland was done. It appeared that within population high variation was observed and it was shown that germplasm of Nagaland was diverse but somewhat uniformly distributed across the state.

Ramdeen *et al.* (2019) conducted a crop improvement programme with an aim to achieve maximum productivity and production, where genetic variability was observed in various qualitative and quantitative traits towards yield.

Srinavasa *et al.* (2021) conducted field test to assess the magnitude of genetic present in taro genotypes during rabi 2020-2021. The experiment was laid in randomized complete block design at College of Horticulture, Mudigere. The analysis of data revealed the presence of considerable variability for all the characters among the genotypes.

2.5 Correlation and Path Coefficient analysis of colocasia

Velayudhan *et al.* (2000) studied correlation and path and coefficients for twelve characters using 72 morphotypic groups (one accession each) of indigenous taro germplasm in Kerala. The characters like cormel number, cormel thickness, plant height, leaf length and leaf width were found to have high positive correlation with cormel yield whereas leaf number was negatively correlated with yield. Cormel number showed maximum positive direct effect on cormel yield. Selection based on the characters like number of cormels, plant height and cormel thickness appeared appeared to be most desirable for yield in Taro.

Pranabjyoti (2007) conducted an experiment in the Horticultural Experimental Farm at ICAR research complex for NEH Region, Umiam, Meghalaya on the biometrical studies of colocasia. The study revealed that the genotypic correlation were higher than phenotypic correlation coefficients for yield and yield contributing characters. Path analysis revealed that leaf area, weight of corms, weight of cormels and number of sucker per plant had positive direct effect on yield. And that the germplasm Panchmukhi, ML -1, Meghlaya Collection- 1 and ML- 9 were found to be suitable under Meghalaya condition with respect to growth, yield and quality parameters.

Orjiand Ogbonna (2015) conducted an experiment in the Linkage Farm of the University of Nigeria to evaluate the morphological differences among the five taro cultivars as well as the relationship between their agronomic traits. The experiment was laid out in randomized complete block design (RCBD) with three replicates. Phenotypically, there were little morphological variations among the five taro cultivars with all of them showing the same even growth habit and oval corm shape. The plant girth and number of leaves per stand were positively and significantly correlated with plant height but negatively correlated with the number of suckers/stand. Also the number of suckers/stand was highly significantly correlated with the number of leaves/stand. The number of cormels/stand also was significantly correlated with the number of suckers/stand. The weight of cormels and corm per stand was positively and significantly correlated with the parameters.

Manvendra *et al.* (2018) evaluated in forty diverse genotypes of taro with the objective to know association among characters, which revealed that the trait yield/ plant had significant and positive phenotypic and genotypic correlation with weight of cormels per plant (g), weight of corms per plant (g), number of cormels per plant and dry matter (%). Path coefficient analysis revealed by weight of cormels per plant followed by weight of corms per plant, length of leaf (cm), dry matter (%), girth of cormels per plant (cm), days to sprouting, exhibited greater direct effect on tuber yield/ plant (g).

Srinivasa *et al.* (2021) conducted an experiment in randomised complete block design at college of Horticulture, Mudigere. Correlation studies revealed that tuber yield per plant exhibited a highly significant and positive correlation with the plant height, number of leaves per plant, leaf length, petiole length, leaf area, cormel weight , number of corms per plant, number of cormels per plant, corm yield per plant and cormel yield per plant both at genotypic and phenotypic level.Path coefficient analysis revealed that traits like plant height, number of leaves per plant , leaf length corm yield per plant and cormel yield per plant exhibited direct effect on tuber yield per plant both at genotypic and phenotypic level .

Tadik *et al.* (2023) conducted an investigation at experimental farm SAS, Nagaland University, Medziphema, Nagaland where fourteen genotypes were procured from three states of north east for the study. Plant height and leaf length showed significant positive correlation with the yield per plant at both phenotypic and genotypic level. Path coefficient analysis revealed that plant height and leaf length exerted positive direct effect and significant positive correlation with yield per plant at genotypic level, which indicated a true relationship among the traits.

2.6 Storage life of colocasia

Gul *et al.* (1990) concluded that treatment with 2000 ppm maleic hydrazide prior to storage of potato tubers, stored at 5 to 7°C and 85 to 90% RH completely suppressed sprouting.

Konwar (1994) reported that the Ahina cultivar of colocasia stored in the sawdust sprouted after 60 days, while the Kaka cultivar sprouted after 45 days and the Neel cultivar after 30 days of storage.

Obetta *et al.* (2002) studied the changes occuring in colocasia corms stored in 3 underground pit storages (pit 1 with 2 pvc vents; pit 2 with pit 1 pvc vent; pit 3 with no pvc vents). They reported that after 8 weeks of storage the highest sprouting index was seen in corms stored in pit 3 (47%), while the lowest weight loss was seen in corms stored in pit 1(34%).

Bhaskar *et al.* (2003) reported that colocasia corms that were inoculated with *Fusarium solani* and stored at 25°C at 90% RH resulted highest weight loss (13.06%).

Sajeev *et al.* (2004) studied the textual characteristics of colocasia cormels during storage and reported that after 20 days of storage, physiological loss in weight was maximum at ambient condition.

Vijaybhaskar *et al.* (2004) studied the physical effects of storing taro corms in pit, heap, sand bed and gunny bags after inoculating the corms with *Sclerotium rolfsii*. They reported that the highest weight loss was observed in pit (31.48%), followed by sand bed (41.38%) and the least in gunny bag (59.66%).

Sajeev *et al.* (2006) reported that after 20 days of storage, physiological loss in weight taro corms was maximum at ambient coditions (31.8 to 44.9°C, 30 to 50% RH) followed by evaporative cool room (26.2 to 33.96°C, 59 to 92% RH) and least was under refrigerated condition (10°C, 65% RH).

Ovono *et al.* (2010) studied the *in vitro* effects of microtuber yams obtained by in vitro culture. They reported that sprouting was seen to be more rapid in microtubers stored for 188 weeks than those stored for 8 weeks. But at 20-28 weeks storage dormancy was observed. They also reported that larger tubers showed better sprouting than smaller ones. Moreover, storage at 25°C permits quicker sprouting than 18°C.Alam *et al.* (2014) reported that rotting of cormels during storage was a serious factor limiting the quantity and quality of planting material. It was reported that highest rotting index of 27.47%, 37.17%

and 39.83 % was recorded in cormels stored on kaccha floor at 30, 60 and 90 DAS respectively.

Alam *et al.* (2014) carried out an investigation in low cost shed to establish a suitable storage method for taro cormels. Findings revealed that sprouting index increased with the advancement of storage period in all the storage methods. The rotting index showed an increasing trend under the different storage methods.

Opata *et al.* (2015) determined that there was progressive loss in fresh weight in each of the storage methods as the period of storage increased. The percent loss in fresh weight was highest for the cocoyam heaped on the ground, followed closely by that stored on raised platform in the same barn and lowest for those buried in the pits. The total number of cocoyam that showed incidence of sprouting or rooting differed in different methods of storage. The highest number of cocoyam that sprouted occurred in those buried while the least number stored on the shelf. The rot incidence started from the first week of storage with progressive increase throughout the whole period of storage.

Magdalena *et al.*(2018) studied and evaluated the storage losses of new varieties of potato and determined the sprouting date of potatoes stored at different temperatures. The study evaluated the influence of weather conditions during the vegetative growth period and sprouting in storage, due to which natural losses and losses caused by sprouting or development of disease and rotting occurred.

Ridwan *et al.*(2023) studied corm rotting as an indicator of deterioration in taro tuber quality. It was indicated with weight loss, length and diameter reduction and changes in corm hardness. The storage period was shown to significantly affect the observed variables. After 4 weeks of storage, the weight and diameter of the corm decreased by 10-30%, while the length of corm decreased by more than 10% after 6 weeks of storage. While the sprouting of corms and cormels was reported that corm sprouting was at a greater rate throughout storage. Larger corms result in more sprouting, whereas smaller corms had lesser sprouting.

CHAPTER III
MATERIALS AND METHODS

MATERIALS AND METHOD

The present investigation entitled **"Characterization of Colocasia (*Colocasia esculenta* L. Schott) genotypes available in Mon district of Nagaland"** was carried out at experimental farm at School of Agricultural Sciences (SAS), Medziphema Nagaland University. The details of the materials and methods used and followed during the experiment for recording various observations and analysis are presented below:-

3.1 Experimental site

The experimental farm of School of Agricultural Sciences (SAS) is located in the foot hills of Nagaland, in Medziphema. It is situated at an altitude of 304.8m above mean sea level and geographically located between 25° 45'43" N latitude and 93° 53'04" E longitude, at an elevation of 305 m above mean sea level, having sub tropical climate.

3.2 Climatic condition

The area of the experimental farm has sub-tropical condition with predominantly high humidity of 70%-80%, moderate temperature with medium to high rainfall. The average rainfall varies from 2000-2500 mm. The temperature ranges between 21℃ to 32℃ during summer and during winter from 10℃ to 15℃.

3.3 Soil conditions

The soil of the experimental site was sandy loam, well drained with a mean pH of 4.4.

3.4 Experimental details

3.4.1 Treatments:

Eighteen genotypes of colocasia were collected from different regions of Mon district to conduct the experiment. The names indicated are in Konyak dialect.

Table 3.1 Meteorological data recorded during the period of crop investigation (2017-2018) Year

Year	Month	Min. temp°C	Max. temp°C	Min. RH%	Max. RH%	Avg. sunshine hour (h)	Total Rainfall (mm)
2017	April	17.1	30.7	52	90	5.4	153.9
	May	21.1	30.5	64	90	4.8	134.2
	June	23.9	32.7	72	92	3.9	266.1
	July	24.6	32.6	74	94	2.6	199.8
	August	25.6	33.6	70	93	4.4	80.4
	September	24.5	32.7	73	95	4.8	157.7
	October	23.1	31.2	74	95	5.2	175.7
	November	15.6	27.9	59	97	6.7	35.2
2018	April	17.9	32.7	34	87	7.0	59.9
	May	21.8	32.9	58	90	4.7	90.8
	June	24.9	32.8	69	93	3.4	125.4
	July	24.7	33.1	73	92	3.3	200.8
	August	25.2	33.3	68	94	4.1	187.2
	September	23.9	26.7	72	94	4.1	173.4
	October	21.4	21.8	73	95	5.9	245.8
	November	16.6	28.6	64	97	7.0	52.8

Source: ICAR, Jharnapani, Nagaland.

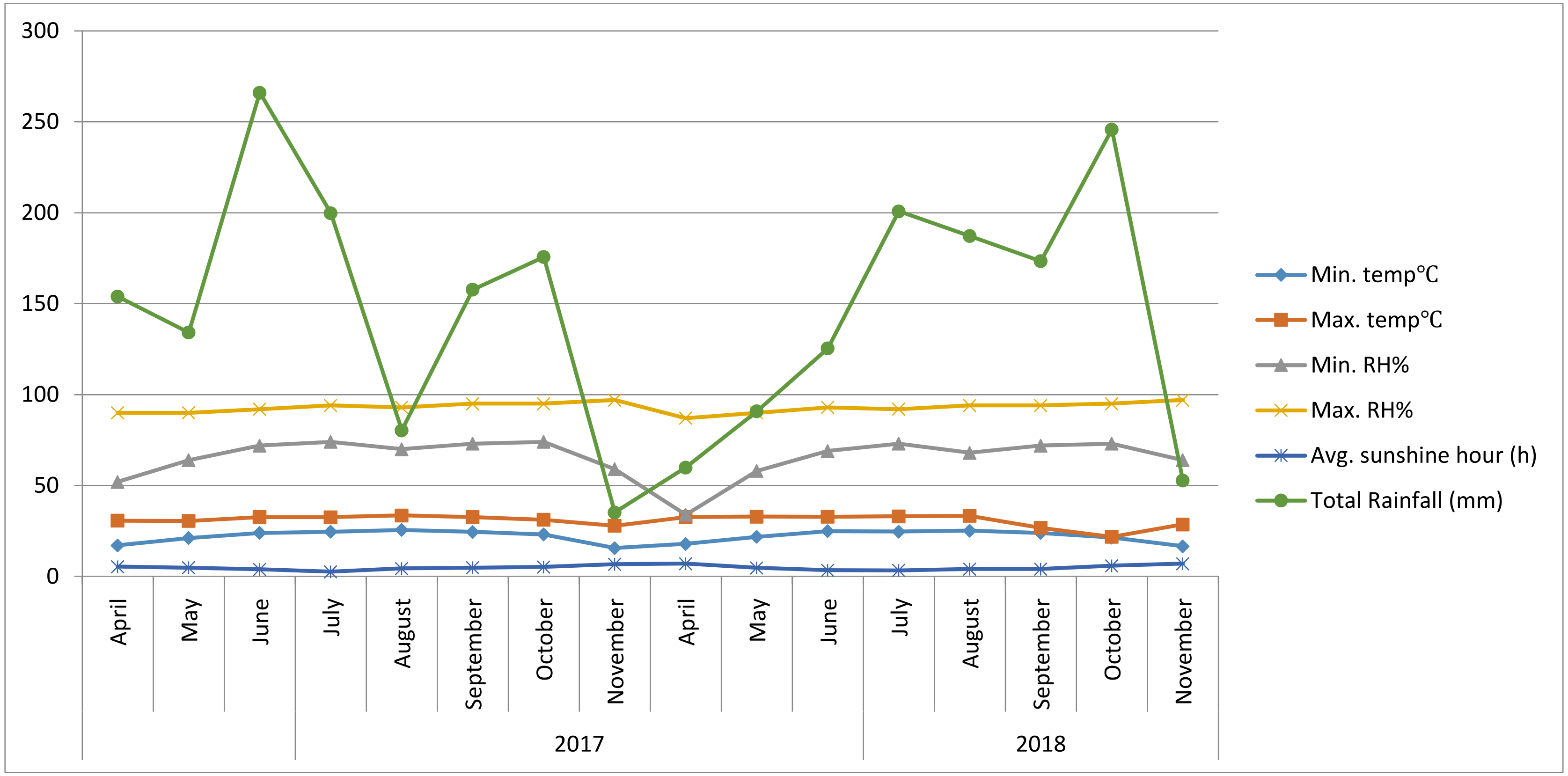


Fig. 3.1: Meteorological data recorded during the period of crop investigation (2017-2018) Year.

Table 3.2 Details of the place of collection of genotypes

Sl. No.	Local Name	Place of Collection	Latitude, Longitude & Altitude	Farmers name & contact number	
1.	Nalon	Tekang	26°53’56” N& 95°4’39” E	Ating 9864793489	Foothill Region
2.	Tosat	Tizit	26.903287°N&95.08262°E	Immo 6909847710	
3.	Tomei	Ngangting	26°53’56” N& 95°4’39” E	Kaisa 9366997910	
4.	Poangmen Along	Ngangting	26.8102°N & 94.8048°E	Kaisa 9366997910	
5.	Tiru Baishi	Tiru	26.8820°N& 94.8819°E	Meilem 9612970301	
6.	Kongan Tongnyak	Kongan Naginimora	26.7457°N& 94.8127°E	Jeiang 9862895962	
7.	Tongmok	Chohnyu	26.546066°N& 95.05719°E	Molem 8413096070	Mid hill Region
8.	Hoakto	Leangha	26.5787°N& 95.0527°E	Aphong 8974064216	
9.	Muksang	Sheanghah	26.66661°N& 94.98926°E	Ayem 9863990269	
10.	Bahnuh	Chenwetnyu	26.5913°N& 94.8986°E	Chingkem 9612785158	
11.	Tongmih	Tuimei	26.5809°N& 95.0790°E	Toang 7630920218	
12.	Tongphak	Totok Chingnyu	26.5913°N&94.8986 °E	Honyem 9862631111	
13.	Pangtong	Kenchenshu	26.4530°N& 94.9891°E	Shamlau 9862914757	High Hill Region
14.	Hentong	Yonghong	26.3789°N& 95.0463°E	Phaiba 9366161714	
15.	Yakteeen	Changlangshu	26.4533°N& 94.9872°E	Wanmei 936608126	
16.	Eang	Tobu	26.4208°N& 95.0136°E	Neangmei 8974354101	
17.	Bujong	Tobu	26.3628°N& 94.9349°E	Neangmei 8974354101	
18.	Tongshe	Monnyakshu	26.3628°N& 94.9349°E	Moba 9366428417	

PLATE 1: General view of the experimental field at SAS, Nagaland University

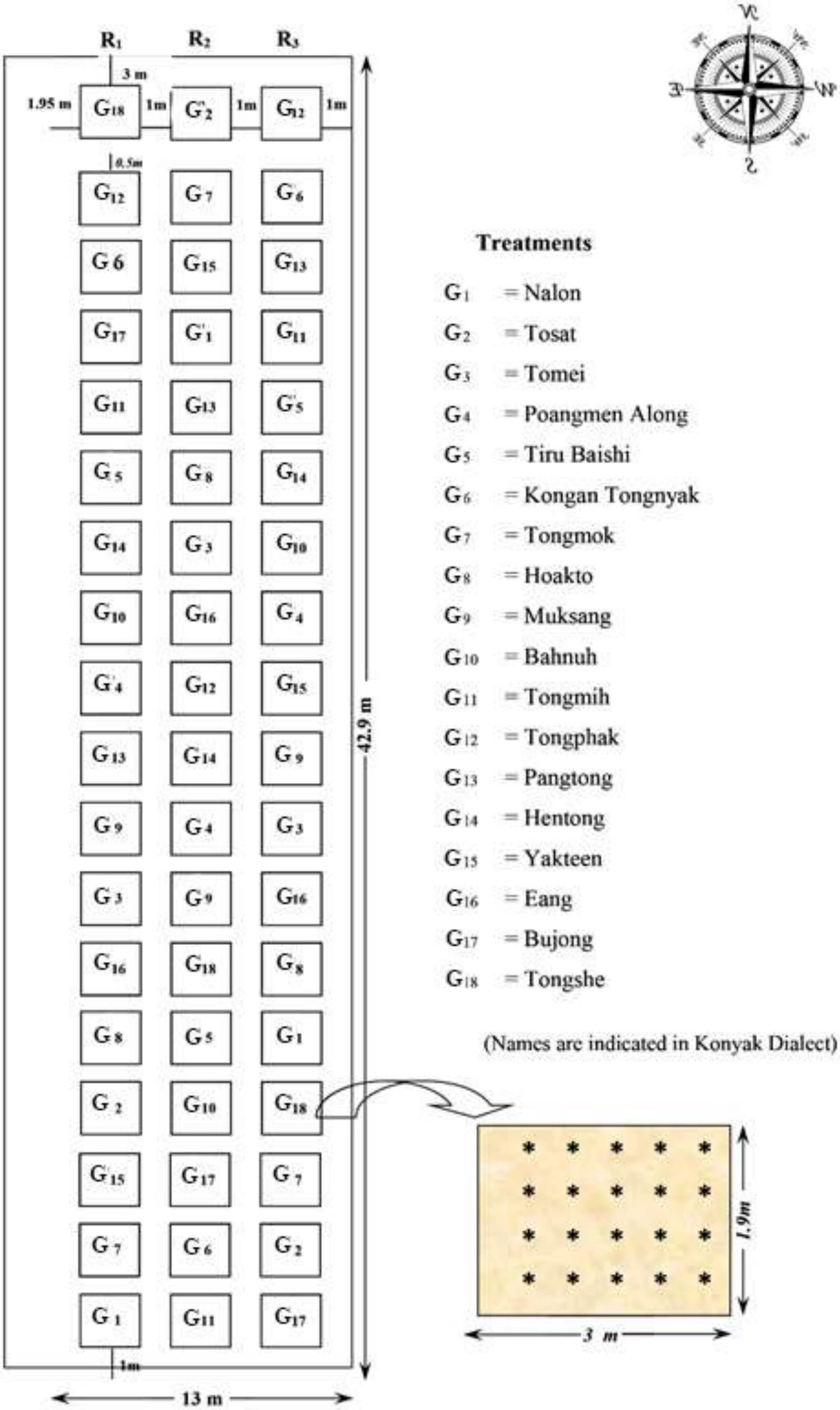


Fig. 3.2: Field Layout of the Experiment in Randomized Completely Block Design (RCBD)

Preparation of field

At Sprouting stage Intercultural operation

PLATE 2: Field preparation and operation

3.4.2 Technical Programme:

Experimental design	: Randomised Completely Block Design
Number of replications	: 3
Number of treatments	: 18
Individual plot size	: 3m × 1.80m
Spacing of planting	: 60 cm × 45 cm
Plants per plot	: 20

The field experiment was carried out for two (2) consecutive years.

3.5 Agronomic practices

3.5.1 Preparatory tillage

The experimental field was ploughed thoroughly by tractor drawn spike tooth cultivator followed by harrowing and leveling. Plant debris and stubbles were removed properly by manual labour.

3.5.2 Layout of the experiment

The plot was measured with measuring tape, then divided into three blocks for replication and within the block eighteen numner of individual plots each measuring 3m x 1.80 m were allotted for treatments. Layout of the plot is shown in Fig 3.2.

3.5.3 Applications of manures and fertilizers:

FYM @ 10t/ha were applied at the time of field preparation. Nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate and mureate of potash, respectively. Half of the nitrogen and full doses of phosphate and potassic fertilizers @ 100 kg N, 60kg P_2O_5 and 80 kg K_2O per ha were applied three days before planting. The remaining half of nitrogen was applied in split doses at 30 days after planting.

3.5.4 Source of genotypes:

The genotypes were collected from the farmers of Mon district, six genotypes each from the foothills, the mid hills and the high hills of Mon.

3.5.5 Planting of genotypes:

Healthy cormels of uniform size were used as planting material. Some colocasia cultivars were cut out from the mother plant in uniform sizes and these were planted in the experimental field for two consecutive years *i.e.* 2017 and 2018.

3.5.6 Intercultural operations and plant protection:

Hand weeding were done to keep the plots weed free. Earthing up was done one month after planting. During the initial period, the plots were irrigated uniformly to maintain adequate moisture until the sprouting are observed. Irrigation was withdrawn afterwards with the sufficient rainfall. Plant protection measures were taken up as per the need.

3.6 Observation recorded

3.6.1 Morphological parameters

3.6.1.1 Corm shape

The corm shape was observed from five randomly selected corms at maturity harvest stage.

3.6.1.2 Cormel shape

The cormel shape was observed from five randomly selected corms at harvest stage.

3.6.1.3 Petiole base colour

The petiole base colour was visually recorded in selected plants using colour chart.

3.6.1.4 Petiole colour

The petiole colour was visually recorded in selected plants using colour chart.

3.6.1.5 Leaf base shape

The leaf base shape was visually observed and recorded from five randomly selected plants.

3.6.1.6 Predominant position (shape) of leaf lamina surface

The predominant position (shape) was visually observed and recorded in five randomly selected plants.

3.6.1.7 Leaf blade margin

The leaf blade margin was visually recorded in five randomly selected plants.

3.6.1.8 Leaf blade colour

The leaf blade colour was visually recorded in five randomly selected plants.

3.6.1.9 Leaf main vein colour

The leaf main vein colour was visually recorded in selected plants at maturity.

3.6.1.10 Vein pattern

The leaf vein pattern was visually recorded in selected plants at maturity.

3.6.2 Growth parameters

3.6.2.1 Plant height (cm)

The plant height was measured from 30 DAP in centimeters by measuring tape, from the ground level to the leaf tip of the longest petiole at 30 days interval from randomly selected plants of each plot.

3.6.2.2 Number of functional leaves

The number of functional leaves were recorded from 30 DAP from 5 randomly selected plants of each plot at 30 days interval. The leaves that have 50 percent unfurled leaf blade blade or less than 50 per cent blade yellowing was considered to be functional.

3.6.2.3 Leaf Area Index (LAI)

The leaf area index of 5 randomly selected plants of each plot was calculated by using the formula given below,

$$\text{LAI} = \frac{\text{Leaf area of sample plant } (\text{cm}^2)}{\text{Field area occupied by the sample plant } (\text{cm}^2)}$$

$$L = \frac{[(1 - \frac{1}{2K})f_b - 1]\ 1n\ \tau}{A(1 - 0.47f_b)}$$

Where,

$$K = \frac{\sqrt{x^2 + \tan\theta^2}}{X + 1.744\ (X + 1.182)^{-0.733}}$$

Between 30 to 120 days after planting, leaves of each cultivar were cut at the midrib petiole intersection and measurements from mid section of length wise and breadth wise were measured.

3.6.2.4 Number of suckers per plant

The number of suckers were recorded from 5 randomly selected plants of each plot at 30 days interval.

3.6.3 Yield parameters

3.6.3.1 Number of corms per plant

At the time of harvest, the number of corms per plant were counted from the sample plants and the average was taken for each treatment.

3.6.3.2 Number of cormels per plant

At the time of harvest, the number of cormels per plant were counted from the sample plants and the average was taken for each treatment.

3.6.3.3Weight of corms per plant(g)

After removing the adhering soil the cleaned corms of sample plants were weighed in physical balance and the average was taken. It is expressed in gram.

3.6.3.4 Weight of cormels per plant (g)

After removing the adhering soil the cleaned cormels of sample plants were weighed in physical balance and average was taken. It is expressed in gram.

3.6.3.5 Yield per plot (kg)

The yield of all the plants in the plot was recorded. It is expressed in kilogram.

3.6.3.6 Yield per ha(q)

The yield of all the plots were recorded after harvesting and then converted into quintals per hectare.

3.6.4 Bio-chemical parameters:

3.6.4.1 Moisture content (%)

The moisture content of corms were determined as per method prescribed by AOAC (1984) by oven drying of 5g sample which were taken in pre weighed crucible and placed in air oven maintained at $105^{o}C$ for 8 hours from each treatment until a constant weight was obtained. The moisture per cent was computed as:

$$\text{Moisture \%} = \frac{\text{Initial weight} - \text{Final weight (g)}}{\text{Initial weight (g)}} \times 100$$

3.6.4.2 Protein content (%)

Protein content of corms was done by digestion of sample after which determination of N (Micro Kjeldahl Steam Distillation Method) was obtained. This method involved digesting 200 mg sample concentrated sulphuric acid with catalyst mixture for 2-3 hours at 100ºC . The ammonia liberated was trapped in boric acid and titrated against 0.1N HCl . From here the percentage value of Protein =N x 6.25.

3.6.4.3 Vitamin C content(mg/100g of corm)

Vitamin C content of corm of each germplasm was determined by 2,6-Dichlorophenol indophenols visual titration method outlined by A.O.A.C (1984) expressed in mg/100g.

$$Vitamin\ C\left(\frac{mg}{100g}\right) = \frac{\text{Titrate volume } \times \text{ Volume make up (25 ml)} \times 10}{\text{Aliquat of extract taken for estimation (5ml) } \times \text{ Volume of sample taken for estimation (2.5ml)}}$$

3.6.4.4 Starch content (%)

The starch content of corm of each germplasm was determined as per the procedure given by Ranganna (1979).

In this method ,10 g of the sample was grinded. The sample was then transferred to a volumetric flask and distilled water was added to make the volume to 100 ml. The contents were filtered through whatman number 1 filter paper. 10 ml of the filtrate was taken in a conical flask, 2-3 drops of phenolphthalein indicator was added. It was then titrated against 0.1 NaOH until a pink colour was obtained, which persisted for atleast 15 seconds.

3.6.4.5 Oxalic acid content (%)

For determination of oxalic acid content of corms, the standard procedure for oxalic acid determination was followed and the percentage of oxalic acid was calculated by the formula,

$$\% \, of \, oxalic \, acid = \frac{\text{Titre value} \times \text{Eq. wt. of oxalic acid for 1ml of KMnO4} \times \text{Normality of KMnO4} \times 100 \quad \times 100}{\text{Aliquot taken} \times \text{weight of sample taken}}$$

3.6.5 Biometrical analysis

3.6.5.1 Analysis of variance (ANOVA)

The data obtained during the period of investigation was statistically analysed. Mean, range of variation, standard error of mean and critical difference for each quantitative characters were worked out by the method of analysis of variance using Randomized Block Design (ANOVA by Panse and Sukhatme,1978)

3.6.5.2 Genotypic and Phenotypic coefficient of variation

According to Burton (1952), the genotypic and phenotypic coefficients of variation was calculated from the following formula-

$$\text{Genotypic coefficient of variation (GCV)} = \frac{\sqrt{\sigma g^2} \times 100}{\bar{x}}$$

$$\text{Phenotypic coefficient of variation (PCV)} = \frac{\sqrt{\sigma p^2} \times 100}{\bar{x}}$$

Where σg^2, σp^2 and x represent the genotypic, phenotypic variance and general mean for the character respectively.

3.6.5.3 Correlation coefficient

To study the genotypic and phenotypic correlation between various pairs of characters, the data was computed as per method suggested by Johnson *et al*. (1955) and Al-Jibouri *et al*. (1958). The correlation are calculated as-

$$\text{Genotypic correlation } rg(x, y) = \frac{COVg(x, y)}{\sqrt{\sigma g^2 x \times \sigma g^2 y}}$$

$$\text{Phenotypic correlation } rp(x, y) = \frac{COVp(x, y)}{\sqrt{\sigma p^2 x \times \sigma p^2 y}}$$

Where, COVg (x, y) and COVp (x, y) are the genotypic and phenotypic covariance between the characters x and y respectively. $\sigma g^2 x$, $\sigma g^2 y$, $\sigma p^2 x$ and $\sigma p^2 y$ are the genotypic variance and phenotypic variance of the corresponding characters x and y respectively.

3.6.5.4 Path coefficient

Direct and indirect effects of various component characters on fruit weight per tree was calculated, Wrights (1921) path coefficient were computed using by correlation coefficients as suggested by Dewey and Lu (1959).

$$\begin{pmatrix} P_1 \\ P_2 \\ - \\ - \\ P_n \end{pmatrix} = \begin{pmatrix} r_{11} & r_{12} & \ldots\ldots & r_{1n} \\ r_{21} & r_{22} & \ldots\ldots & r_{2n} \\ - & - & \ldots\ldots & - \\ - & - & \ldots\ldots & - \\ r_{n1} & r_{n2} & \ldots\ldots & r_{nn} \end{pmatrix}^{-1} \begin{pmatrix} r_{y1} \\ r_{y2} \\ - \\ - \\ r_{yn} \end{pmatrix}$$

Where, r_{11} to r_{nn} represents the correlation coefficients among independent variables, r_{y1} to r_{yn}, are correlatios coefficient between dependent and independent variables, and P_1 and P_n are direct paths. Indirect paths for the first variable are r_{11} x P_1, r_{12} x P_2 .... r_{1n} x P_n.

$$\text{Residual effect} = \sqrt{1 - P_1 \times r_{y1} - P_2 \times r_{y2} - \ldots\ldots - P_n \times r_{ym}}$$

3.6.6 Observations during storage

The observations taken to study the storage life of colocasia under ambient temperature was taken at 30 days interval, starting from 30 days after storage.

3.6.6.1 Physiological loss in weight (PLW)

At the beginning of the storage period,initial weight of the corms was taken. Observations were taken at 30 days interval. Percent physiological loss in weight for each observation was calculated using the formula:

$$\text{PLW (\%)} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

3.6.6.2 Sprouting index (%)

Sprouting of corms was determined by visually observing the number of sprouted corms in the storage condition. The sprouted corms were determined by the first occurrence of sprouts in the eyes. The sprouting index was determined using the formula:

$$\text{Sprouting Index (\%)} = \frac{\text{Number of sprouted corms}}{\text{Total number of corms}} \times 100$$

3.6.6.3 Rotting index (%)

The soft corms felt by touch was regarded as rotted corms. The observation will be done at 30 days interval and the rotting index was determined using the formula:

$$\text{Rotting Index (\%)} = \frac{\text{Number of rotted corms}}{\text{Total number of corms}} \times 100$$

CHAPTER IV
RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

The results and discussion of the current investigation, "**Characterization of Colocasia (*Colocasia esculenta* L Schott) genotypes available in Mon district of Nagaland**" are given in this chapter.To make the results more comprehensive, the results from the current investigations have been properly supported by the corresponding tables and figures.

4.1 PHYSICO-CHEMICAL CHARACTERS

4.1.1 Morphological parameters

4.1.1.1 Corm shape

The observations related to corm shape of colocasia genotypes have been displayed in the table 4.1. The colocasia genotypes recorded five kinds of corm shape namely round, elliptical or oval, conical, cylindrical and elongated. Two genotypes (G-11,G-14) were found to have elliptical shape, two genotypes was found conical (G-6 and G-7), one genotypes was found cylindrical (G-17) in shape, eight genotypes (G-1, G-2, G-3, G-5, G-9 ,G-10, G-13and G-16) were found to be round and the rest of the genotypes were found to have elongated shape (G-4, G-8,G-15 and G-18). This findings were similarly reported by Khatemenla *et al* (2019), Sufia *et al* (2024).

4.1.1.2 Cormel shape

The observations related to cormel shape of colocasia genotypes were displayed in the table 4.1. The colocasia genotypes recorded five kinds of cormel shape namely round, elongated or irregular, elliptical or oval ,cylindrical and conical. Eleven genotypes (G-1, G-2, G-3, G-4, G-5,G-8, G-9, G-10.G-13 , G-14, G-16) were found to have round shape, four genotypes (G-12, G-15, G-17 and G-18) were found to have elongated shape, G-6 and G-11 were found to have elliptical or oval shape and G-7 was found to have conical shape cormels. This findings were similarly reported by Khatemenla *et al*. (2019) and Sufia *et al.* 2024).

4.1.1.3 Petiole base colour

The colocasia genotypes recorded five kinds of petiole base colour namely green, yellow, creamish, pinkish and purple (table 4.2). three genotypes (G-3, G-7, and G-10) were found to have green colour, four genotypes (G-2, G-8, G-11 and G-14) were found to have yellow colour, seven genotypes (G-1,G-4, G-9, G-12, G-13, G-15 and G-17) were found creamish, G-5 was found pinkish and remaining genotypes (G-6, G-16 and G-18) were found to have purple petiole base colour. This similar findings have been reported by Beyene 2023.

4.1.1.4 Petiole colour

The observations related to petiole colour of colocasia genotypes have been displayed in the table 4.2. The colocasia genotypes recorded two kinds of petiole colour namely green and purple. Three genotypes (G-6, G-15 , G-16) were found to have purple petiole colour, G-18 was found to be reddish and the rest of the genotypes were found to have green petiole colour. Similar findings have been reported by Vinutha *et al.* (2015).

4.1.1.5 Leaf base shape

The observations related to leaf base shape of colocasia genotypes were shown in table 4.3. All genotypes have reported peltate leaf base shape. Simliar findings have been reported by Manzanno *et al*. (2018).

4.1.1.6 Predominant position (shape) of leaf lamina surface

The observations related to predominant position (shape) of leaf lamina surface have been displyed in table 4.3. All genotypes have reported erect apex down position of leaf lamina. Similar findings have been reported by Bammite *et al* .(2018).

4.1.1.7 Leaf blade margin

The colocasia genotypes recorded in table 4.4 exhibited two types of leaf blade margin , namely undulate type and sinuate type. Three genotypes (G-6, G-15 and G-17) were found to have sinuate type of leaf blade margin. The rest of the genotypes were found to have undulate leaf blade margin. This similar findings have been reported by. Lebot *et al* .(2010), Beyene 2013.

4.1.1.8 Leaf blade colour

Onobservation, it was recorded in table 4.4 that the genotypes (G-1,G-2, G-3, G-4, G-5, G-6, G-7,G-8, G-10, G-11, G-17) were found to have dark green blade colour. While the genotypes (G-9, G-12, G-13, G-14, G-15,G-16 and G-18) were found to have green leaf blade colour. Similar findings have been reported by, Lebot *et al* .(2010), Vinutha *et al.* (2015).

4.1.1.9 Leaf main vein colour

The observations related to leaf main vein colour of colocasia genotypes have been recorded in table 4.5. In the genotypes (G-1, G-7,G-8,G-10,G-14,G-15 ,G-17 and G-18) the leaf main vein colour was found to be green. Yellow leaf main vein colour was found in genotypes G-2 and G-9. Whitish leaf main vein colour was found in genotypes (G-3, G-4, G-5, G-11, G-12, G-13, G-16). Purple leaf main vein colour was recorded in G-6. Simliar findings have been reported by Lebot *et al* .(2010), Manzanno*et al*. (2018),

4.1.1.10 Vein pattern

The observations related to vein pattern have been recorded in table 4.5. The vein pattern observed in almost all the genotypes was Y pattern. In genotype G-15 the vein pattern observed was Y pattern and extended tosecondary veins. Similar findings have been reported by Paul *et al.* (2011).

Table 4.1: Morphological parameters of various colocasia genotypes

Genotype	Corm shape	Cormel shape
Genotype-1	Round	Round
Genotype-2	Round	Round
Genotype-3	Round	Round
Genotype-4	Elongated	Round
Genotype-5	Round	Round
Genotype-6	Conical	Elliptical/oval
Genotype-7	Conical	Conical
Genotype-8	Elongated	Round
Genotype-9	Round	Round
Genotype-10	Round	Round
Genotype-11	Elliptical/oval	Elliptical/oval
Genotype-12	Clustered/ Flat and multifaced	Elongated
Genotype-13	Round	Round
Genotype-14	Elliptical/oval	Round
Genotype-15	Elongated	Elongated
Genotype-16	Round / Clustered	Round
Genotype-17	Cylindrical	Elongated
Genotype-18	Elongated	Elongated

Table 4.2: Morphological parameters of various colocasia genotypes

Genotype	Petiole base colour	Petiole colour
Genotype-1	Creamish	Green
Genotype-2	Yellow	Green
Genotype-3	White	Green
Genotype-4	Creamish	Green
Genotype-5	Pinkish	Green
Genotype-6	Purple	Purple
Genotype-7	Green	Green
Genotype-8	Yellow	Green
Genotype-9	Creamish	Green
Genotype-10	Green	Green
Genotype-11	White	Green
Genotype-12	Creamish	Green
Genotype-13	White	Green
Genotype-14	Creamish	Green
Genotype-15	Reddish	Purple
Genotype-16	Creamish	Green
Genotype-17	Reddish	Purple
Genotype-18	Green	Reddish

Table 4.3: Morphological parameters of various colocasia genotypes

Genotype	Leaf base shape	Predominant position (shape)of leaf lamina surface
Genotype-1	Peltate	Erect- apex down
Genotype-2	Peltate	Erect-apex down
Genotype-3	Peltate	Erect-apex down
Genotype-4	Peltate	Erect-apex down
Genotype-5	Peltate	Erect-apex down
Genotype-6	Peltate	Erect-apex down
Genotype-7	Peltate	Erect-apex down
Genotype-8	Peltate	Erect-apex down
Genotype-9	Peltate	Erect-apex down
Genotype-10	Peltate	Erect-apex down
Genotype-11	Peltate	Erect-apex down
Genotype-12	Peltate	Erect-apex down
Genotype-13	Peltate	Erect-apex down
Genotype-14	Peltate	Erect-apex down
Genotype-15	Peltate	Erect-apex down
Genotype-16	Peltate	Erect-apex down
Genotype-17	Peltate	Erect-apex down
Genotype-18	Peltate	Erect-apex down

Table 4.4: Morphological parameters of various colocasia genotypes

Genotype	Leaf blade margin	Leaf blade colour
Genotype-1	Undulate	Dark Green
Genotype-2	Undulate	Dark Green
Genotype-3	Undulate	Dark Green
Genotype-4	Undulate	Dark Green
Genotype-5	Undulate	Dark Green
Genotype-6	Undulate	Dark Green
Genotype-7	Undulate	Dark Green
Genotype-8	Undulate	Dark Green
Genotype-9	Undulate	Green
Genotype-10	Undulate	Dark Green
Genotype-11	Sinuate	Dark Green
Genotype-12	Sinuate	Green
Genotype-13	Undulate	Green
Genotype-14	Undulate	Green
Genotype-15	Sinuate	Green
Genotype-16	Undulate	Green
Genotype-17	Sinuate	Dark Green
Genotype-18	Undulate	Green

Table 4.5: Morphological parameters of various colocasia genotypes

Genotype	Leaf main vein colour	Vein pattern
Genotype-1	Green	Y pattern
Genotype-2	Yellow	Y pattern
Genotype-3	Whitish	Y pattern
Genotype-4	Whitish	Y pattern
Genotype-5	Whitish	Y pattern
Genotype-6	Purple	Y pattern
Genotype-7	Green	Y pattern
Genotype-8	Green	Y pattern
Genotype-9	Yellow	Y pattern
Genotype-10	Green	Y pattern
Genotype-11	Whitish	Y pattern
Genotype-12	Whitish	Y pattern
Genotype-13	Whitish	Y pattern
Genotype-14	Green	Y pattern
Genotype-15	Green	Y pattern and extending to secondary veins
Genotype-16	Whitish	Y pattern
Genotype-17	Green	Y pattern
Genotype-18	Green	Y pattern

4.1.2 Growth parameters of colocasia genotypes

4.1.2.1 Plant height

Plant height of eighteen colocasia genotypes were recorded as shown in the table 4.6 and fig 4.1.utilizing a measuring scale at the fully mature stage. Maximum plant height was observed in genotype 8 (98.43 cm) followed by genotypes 10 (92.33 cm) and genotypes 4 (92.04 cm). However, minimum plant height was observed in genotypes 13 (47.24 cm).

The eighteen colocasia genotypes under the study for 1st year, 2nd year and pooled data showed plant height at full maturity. The results have suggested that for a large number of genotypes under investigation, it is suggestive that for the genotypes to reach optimum plant height, medium spacing is ideal. This is also suggestive of the findings of maturity period and spacing in cocoyam plants (Mwenye 2009).

4.1.2.2 Number of functional leaves

The data taken for number of functional leaves are given in the table 4.7. and fig 4.2. Genotype 4 (21.11) recorded highest for number of leaves followed by genotype 7 (20.47) and genotype 12 (17.67). However, number of functional leaves was recorded lowest in genotype 18 (6.06).

The more the functional leaves, the better is the photosynthetic rate which supports positive features of the most contributing characters. (Akwee *et al.*, 2015).

4.1.2.3 Leaf Area Index(LAI)

The observation on Leaf Area Index has been presented in the table 4.8 and fig 4.3. Genotype 8 (0.28) recorded maximum for leaf area index followed by genotype 11 (0.26) and genotype 1, 4 & 18 (0.25). Leaf area was recorded minimum in genotype 15 (0.13)

These observations suggests that the height of the plant is directly proportional to the size of the leaf, because the leaf photosynthetic rate is associated with the plant height (Bishop 1991). The resultant effect of leaves having higher leaf area index may be due to early rate of establishment, higher plant height, better plant establishment, proper photosynthesis due to efficient utilization of sunlight (Lewu *et al*., 2017). In leaf area index significant variation has been observed in the present study , as the interaction effect between the genotypes and environment was significant. The size of colocasia leaf is strongly influenced by the environent as colocasia have a high requirement for moisture because of large transpiring surfaces. (Lebot *et al*., 2010).

4.1.2.4 Number of suckers per plant

The data relating to number of suckers per plant is provided in the table 4.9 and fig 4.4..Genotype 7 (6.11) recorded highest for number of suckers per plant followed by genotype 4 (6.00) and genotype 8 (5.62). However, number of suckers per plant was recorded lowest in genotype 18 (2.06).

The sucker formation is an important trait in colocasia selection and studies, the more the number of suckers, the popular is the genotype for breeding programmes and *ex- situ* conservation of genetic resources, because of the fact that suckers are the sources of planting materials. (Akwee *et al*.,2015).

Table 4.6: Plant height (cm) of colocasia genotypes

Genotypes	Plant height (cm)		
	1st year	**2nd year**	**Pooled**
Genotype -1	65.14	69.56	67.31
Genotype -2	85.14	87.12	86.24
Genotype -3	65.12	63.11	65.91
Genotype – 4	91.56	92.64	92.04
Genotype -5	74.52	78.56	76.65
Genotype -6	60.23	63.21	61.50
Genotype -7	78.98	79.78	79.49
Genotype -8	97.14	99.2	98.43
Genotype -9	56.33	57.04	56.84
Genotype -10	92.1	92.68	92.33
Genotype -11	82.34	83.98	83.54
Genotype -12	57.81	59.46	58.81
Genotype -13	47.12	47.36	47.24
Genotype -14	67.21	67.64	67.42
Genotype -15	51.03	52.79	51.55
Genotype -16	51.35	53.02	52.75
Genotype -17	66.01	67.21	66.39
Genotype -18	78.32	80.21	79.83
Mean	71.34	71.35	71.35
C.V.	5.72	5.73	5.73
F ratio	42.17	42.18	42.18
S.E.	2.35	2.36	2.36
C.D. 5%	6.78	6.79	6.79
C.D. 1%	9.11	9.12	9.12
Range Lowest	47.23	47.24	47.24
Range Highest	98.42	98.43	98.43

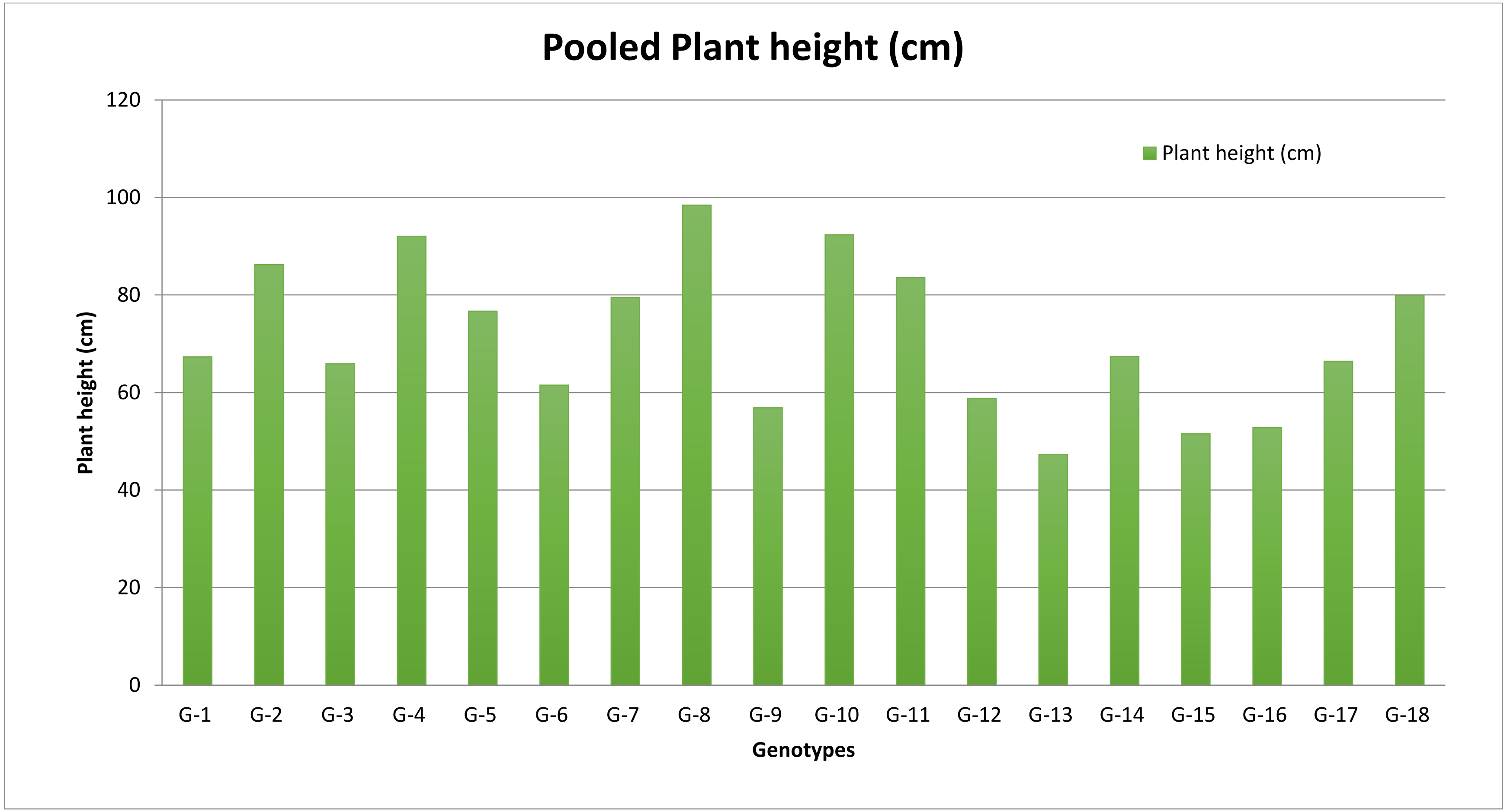


Fig 4.1: Plant height (cm) of various colocasia genotypes

G_1 G_2

G_3 G_4

G_5 G_6

PLATE 3 :Corm variability in colocasia genotypes

G_7 G_8

G_9 G_{10}

G_{11} G_{12}

PLATE 4 :Corm variability in colocasia genotypes

G_{13}

G_{14}

G_{15}

G_{16}

G_{17}

G_{18}

PLATE 5 : Corm variability in colocasia genotypes

At 30 DAS

At 60 DAS

PLATE 6: Growth stages of colocasia at 30 DAS and 60 DAS

At 90 DAS

At 120 DAS

PLATE 7: Growth stages of colocasia at 90 DAS and 120 DAS

Table 4.7: Number of functional leaves of colocasia genotypes

Genotypes	Number of functional leaves		
	1st year	2nd year	Pooled
Genotype -1	15.70	15.72	15.71
Genotype -2	11.25	11.27	11.26
Genotype -3	13.97	14.01	13.99
Genotype - 4	21.09	21.13	21.11
Genotype -5	17.54	17.56	17.55
Genotype -6	13.64	13.67	13.65
Genotype -7	20.45	20.49	20.47
Genotype -8	16.70	16.72	16.71
Genotype -9	11.41	11.47	11.44
Genotype -10	16.33	16.33	16.33
Genotype -11	10.20	10.20	10.20
Genotype -12	17.66	17.68	17.67
Genotype -13	10.75	10.77	10.76
Genotype -14	12.75	12.77	12.76
Genotype -15	10.45	10.47	10.46
Genotype -16	14.73	14.75	14.74
Genotype -17	11.70	11.72	11.71
Genotype -18	6.05	6.07	6.06
Mean	14.01	14.03	14.03
C.V.	7.44	7.45	7.45
F ratio	41.24	41.25	41.25
S.E.	0.59	0.60	0.60
C.D. 5%	1.73	1.72	1.73
C.D. 1%	2.32	2.33	2.33
Range Lowest	6.05	6.06	6.06
Range Highest	21.1	21.11	21.11

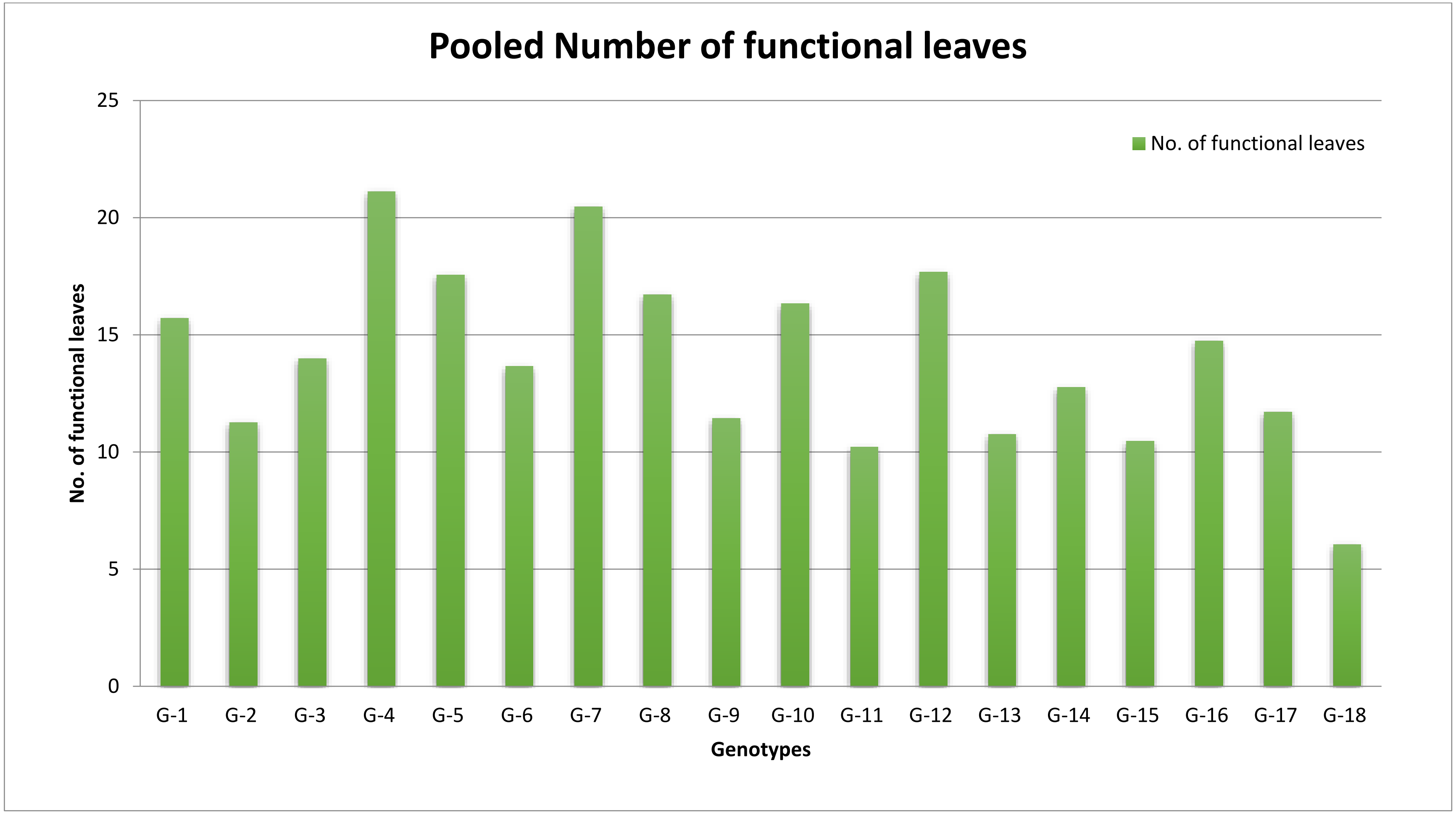


Fig 4.2: Number of functional leaves of various colocasia genotypes

Table 4.8: Leaf Area Index (LAI) of colocasia genotypes

Genotypes	**LAI**		
	1st year	**2nd year**	**Pooled**
Genotype -1	0.24	0.26	0.25
Genotype -2	0.21	0.23	0.22
Genotype -3	0.20	0.20	0.20
Genotype -4	0.23	0.27	0.25
Genotype -5	0.21	0.23	0.22
Genotype -6	0.13	0.15	0.14
Genotype -7	0.20	0.20	0.20
Genotype -8	0.27	0.29	0.28
Genotype -9	0.17	0.19	0.18
Genotype -10	0.20	0.20	0.20
Genotype -11	0.25	0.27	0.26
Genotype -12	0.16	0.16	0.16
Genotype -13	0.14	0.16	0.15
Genotype -14	0.17	0.21	0.19
Genotype -15	0.12	0.14	0.13
Genotype -16	0.15	0.15	0.15
Genotype -17	0.18	0.20	0.19
Genotype -18	0.24	0.26	0.25
Mean	0.19	0.20	0.20
C.V.	14.08	14.09	14.09
F ratio	7.17	7.18	7.18
S.E.	0.01	0.01	0.01
C.D. 5%	0.04	0.04	0.04
C.D. 1%	0.05	0.06	0.06
Range Lowest	0.12	0.13	0.13
Range Highest	0.27	0.25	0.28

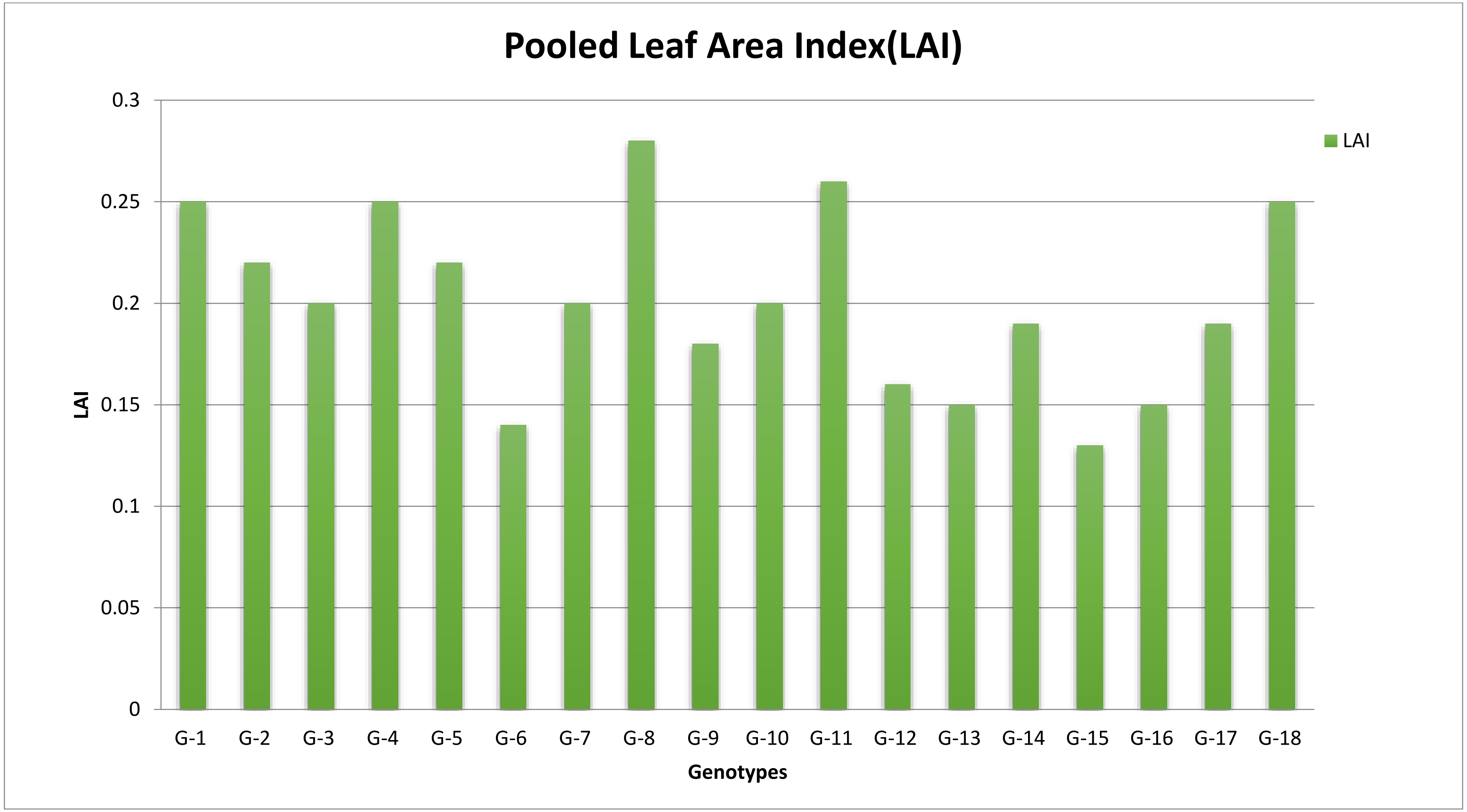


Fig 4.3: LAI of various colocasia genotypes

Table 4.9: Number of suckers per plant of colocasia genotypes

Genotypes	Number of suckers per plant		
	1st year	2nd year	Pooled
Genotype -1	4.48	4.50	4.49
Genotype -2	3.52	3.54	3.53
Genotype -3	3.45	3.47	3.46
Genotype -4	6.00	6.01	6.00
Genotype -5	4.1	4.2	4.2
Genotype -6	3.10	3.10	3.10
Genotype -7	6.10	6.12	6.11
Genotype -8	5.61	5.63	5.62
Genotype -9	3.95	3.97	3.96
Genotype -10	5.04	5.08	5.06
Genotype -11	4.76	4.78	4.77
Genotype -12	5.40	5.42	5.41
Genotype -13	2.61	2.63	2.62
Genotype -14	4.27	4.29	4.28
Genotype -15	2.73	2.75	2.74
Genotype -16	4.47	4.49	4.48
Genotype -17	3.31	3.35	3.33
Genotype -18	2.05	2.07	2.06
Mean	4.17	4.18	4.18
C.V.	8.44	8.45	8.45
F ratio	33.6	33.61	33.61
S.E.	0.19	0.20	0.20
C.D. 5%	0.57	0.58	0.58
C.D. 1%	0.77	0.78	0.78
Range Lowest	2.05	2.06	2.06
Range Highest	6.1	6.11	6.11

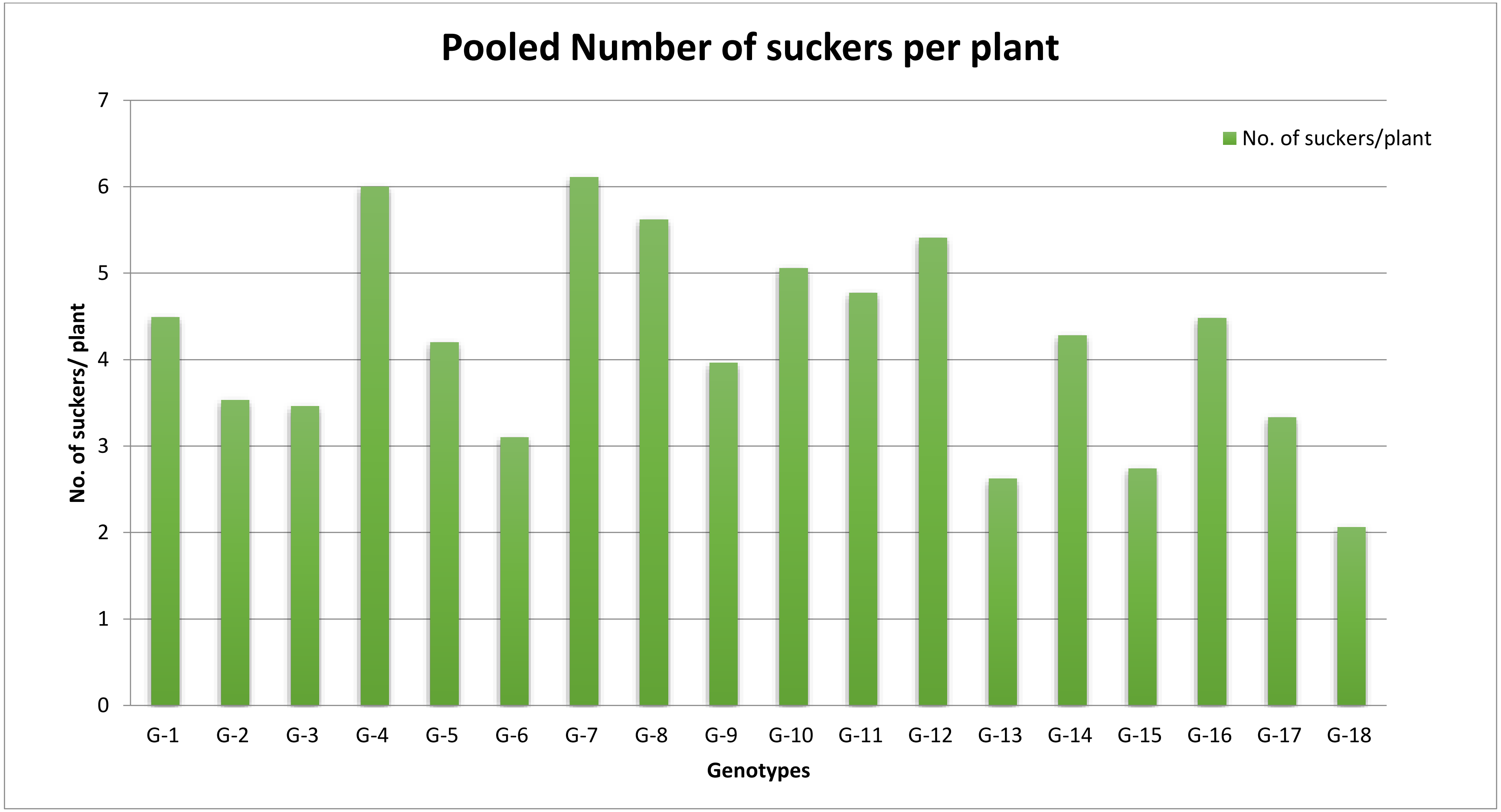


Fig 4.4: Number of suckers per plant of various colocasia genotypes

4.1.3 Biochemical parameters of colocasia genotypes

4.1.3.1 Moisture (%)

The data relating to moisture (%) were displayed in the table 4.10 and fig 4.5. The maximum moisture (%) was found in genotype 4 (84.46) followed by genotype 8 (84.44) and genotype 17 (81.18). Minimum moisture (%) was found in genotype 1(48.61).

Data on moisture percentage showed significant variation among genotypes. Moisture content is not a fixed property, and is dependent upon various factors such as cultivar, yield and also environment factors such as temperature, relative humidity (Sarmah, 1997).

4.1.3.2 Protein (%)

The data regarding to protein has been displayed in the table 4.11 and 4.6. The maximum protein (%)was found in genotype 4 (2.44) followed by genotype 15 (2.40) and genotype 1 (2.39). Minimum protein (%)was found in genotype 11 (1.23). Similar findings were also reported by Jannatul *et al.*(2023).

4.1.3.3 Vitamin C (mg/100g)

The data related to Vitamin C has been presented in table 4.12 and fig 4.7. The highest Vitamin C was found in genotype 3 (134.04) followed by genotype 1 (130.9) and genotype 16 (130.37). Minimum Vitamin C was found in genotype 7 (91.52). Similar findings have been reported by Willis *et al.* (1983).

4.1.3.4 Starch content (%)

The data about starch content has been shown in table 4.13 and fig 4.8. The maximum starch content was found in genotype 1 (16.87) followed by genotype 3 (16.40) and genotype 16 (15.03). Minimum starch content was found in genotype 8 (10.52). Similar finding were also reported by Jannatul *et al*. (2023)

4.1.3.5 Oxalic acid (%)

The data related to oxalic acid (%) has been presented in table 4.14 and fig 4.9. The minimum Oxalic acid (%) was found in genotype 1 (0.3%) followed by genotype 4 (0.42 %) and genotype 5 (0.43 %). Maximum Oxalic acid (%) was found in genotype 16 (0.83%).

It has been accepted that oxalates do not pose a hazard, since it is leached out during cooking as colocasia is not consumed raw. Significant differences were found in oxalic acid content among cultivars. Parallel results were also reported by Huang Chien-Chun *et al*. (2007), Khush *et al* (2023).

Table 4.10: Moisture % of colocasia genotypes

Moisture (%)			
Genotypes	**1st Year 2017**	**2nd year 2018**	**Pooled**
Genotype -1	48.62	48.60	48.61
Genotype -2	66.87	66.9	66.89
Genotype -3	79.62	79.63	79.63
Genotype -4	84.44	84.47	84.46
Genotype -5	56.84	56.84	56.84
Genotype -6	80.42	80.45	80.44
Genotype -7	67.77	67.79	67.78
Genotype -8	84.43	84.45	84.44
Genotype -9	80.32	80.34	80.33
Genotype -10	67.47	67.49	67.48
Genotype -11	80.04	80.04	80.04
Genotype -12	74.76	74.76	74.76
Genotype -13	79.22	79.24	79.23
Genotype -14	68.67	68.65	68.66
Genotype -15	63.37	63.35	63.36
Genotype -16	52.42	52.4	52.41
Genotype -17	81.16	81.19	81.18
Genotype -18	72.09	72.09	72.99
Mean			71.64
C.V.			5.63
F ratio			21.94
S.E.			2.33
C.D. 5%			6.69
C.D. 1%			8.99
Range Lowest			48.61
Range Highest			84.46

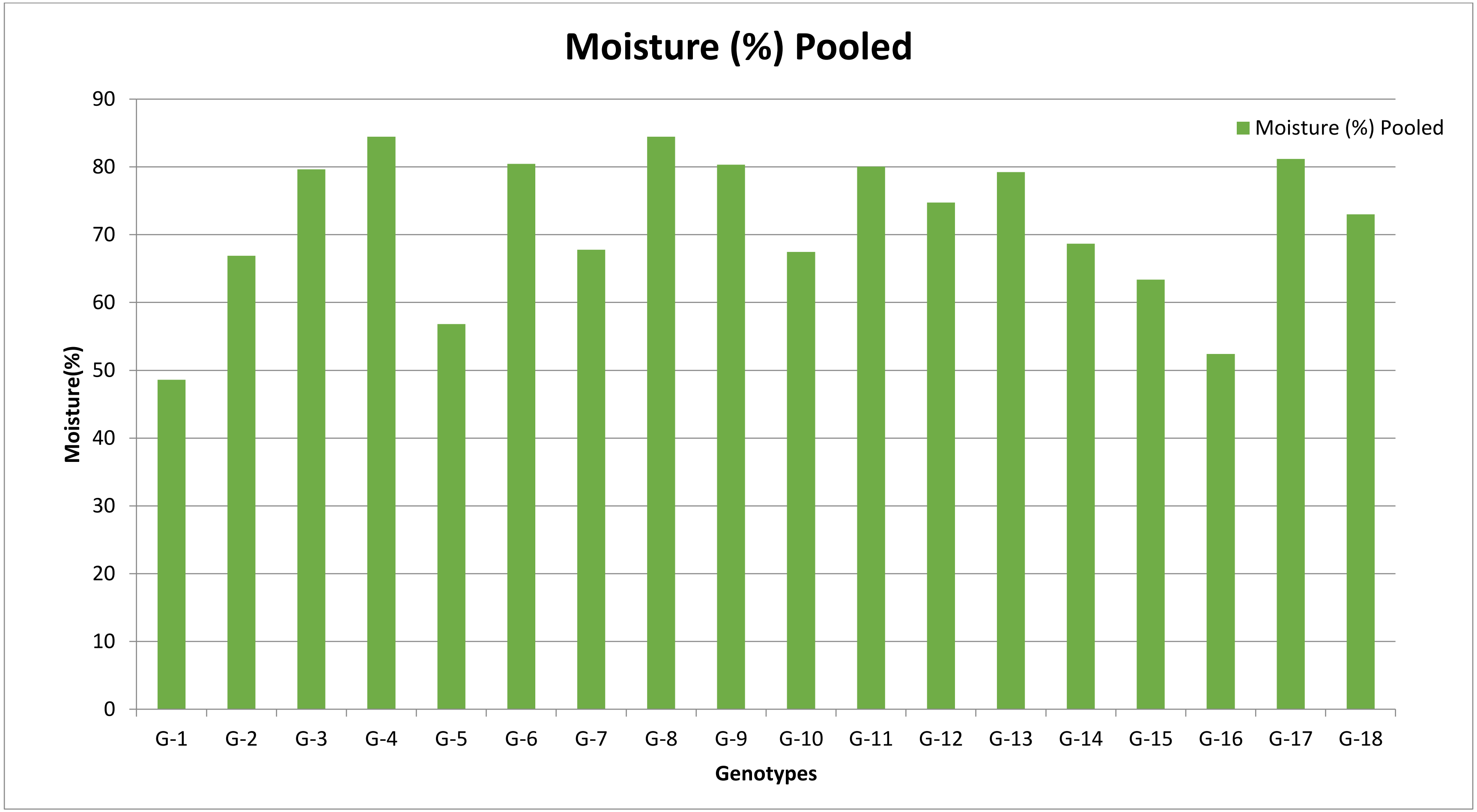


Fig 4.5: Moisture (%) of various colocasia genotypes

Table 4.11: Protein % of colocasia genotypes

Protein (%)			
Genotypes	1st Year 2017	2nd Year 2018	Pooled
Genotype -1	2.4	2.37	2.39
Genotype -2	1.96	1.96	1.96
Genotype -3	2.17	2.17	2.17
Genotype -4	2.43	2.45	2.44
Genotype -5	2.05	2.05	2.05
Genotype -6	2.3	2.3	2.3
Genotype -7	1.97	1.97	1.97
Genotype -8	1.84	1.82	1.83
Genotype -9	2.25	2.25	2.25
Genotype -10	2.35	2.32	2.33
Genotype -11	1.25	1.22	1.23
Genotype -12	2.1	2.1	2.1
Genotype -13	2.25	2.24	2.26
Genotype -14	2.18	2.16	2.17
Genotype -15	2.40	2.40	2.40
Genotype -16	2.39	2.37	2.38
Genotype -17	1.91	1.91	1.91
Genotype -18	1.83	1.81	1.82
Mean			2.11
C.V.			5.99
F ratio			16.56
S.E.			0.07
C.D. 5%			0.21
C.D. 1%			0.28
Range Lowest			1.23
Range Highest			2.44

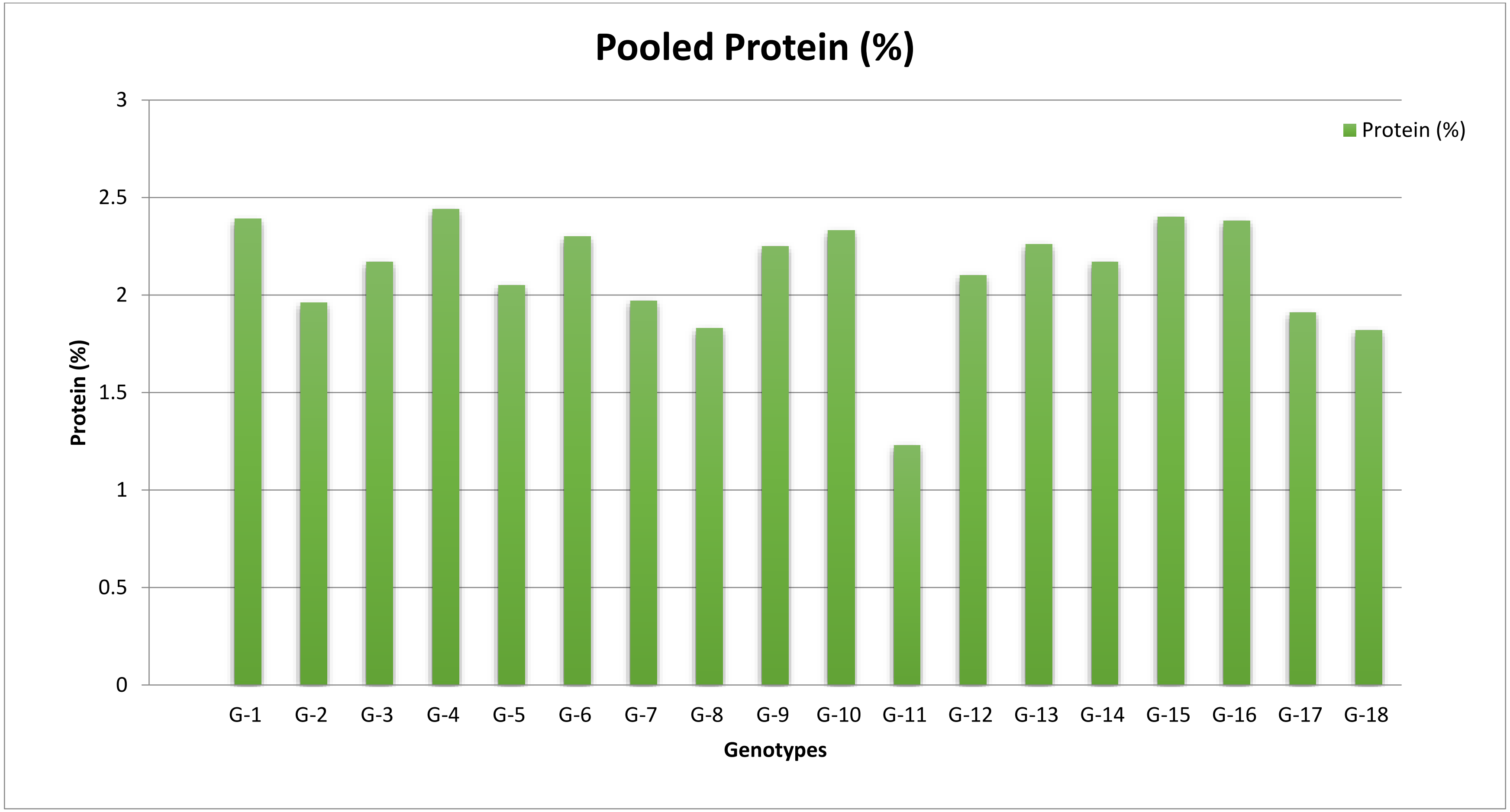


Fig 4.6: Protein (%) of various colocasia genotypes

Table 4.12: Vitamin C (mg/ 100g) of colocasia genotypes

Vitamin C (mg/100g)			
Genotypes	**1st Year 2017**	**2nd Year 2018**	**Pooled**
Genotype -1	130.9	130.9	130.9
Genotype -2	103.85	103.83	103.84
Genotype -3	134.04	134.04	134.04
Genotype -4	124.26	124.26	124.26
Genotype -5	114.96	119.95	114.95
Genotype -6	94.7	94.7	94.7
Genotype -7	91.53	91.51	91.52
Genotype -8	100.37	100.35	100.36
Genotype -9	112.82	112.82	112.82
Genotype -10	109	109	109
Genotype -11	107.5	107.48	107.49
Genotype -12	106.84	106.82	106.83
Genotype -13	122.97	122.97	122.97
Genotype -14	91.77	91.77	91.77
Genotype -15	110.38	110.36	110.37
Genotype -16	130.38	130.36	130.37
Genotype -17	122.89	122.86	122.87
Genotype -18	116.60	116.60	116.60
Mean			112.53
C.V.			11.46
F ratio			3.16
S.E.			7.44
C.D. 5%			21.41
C.D. 1%			28.74
Range Lowest			91.52
Range Highest			134.04

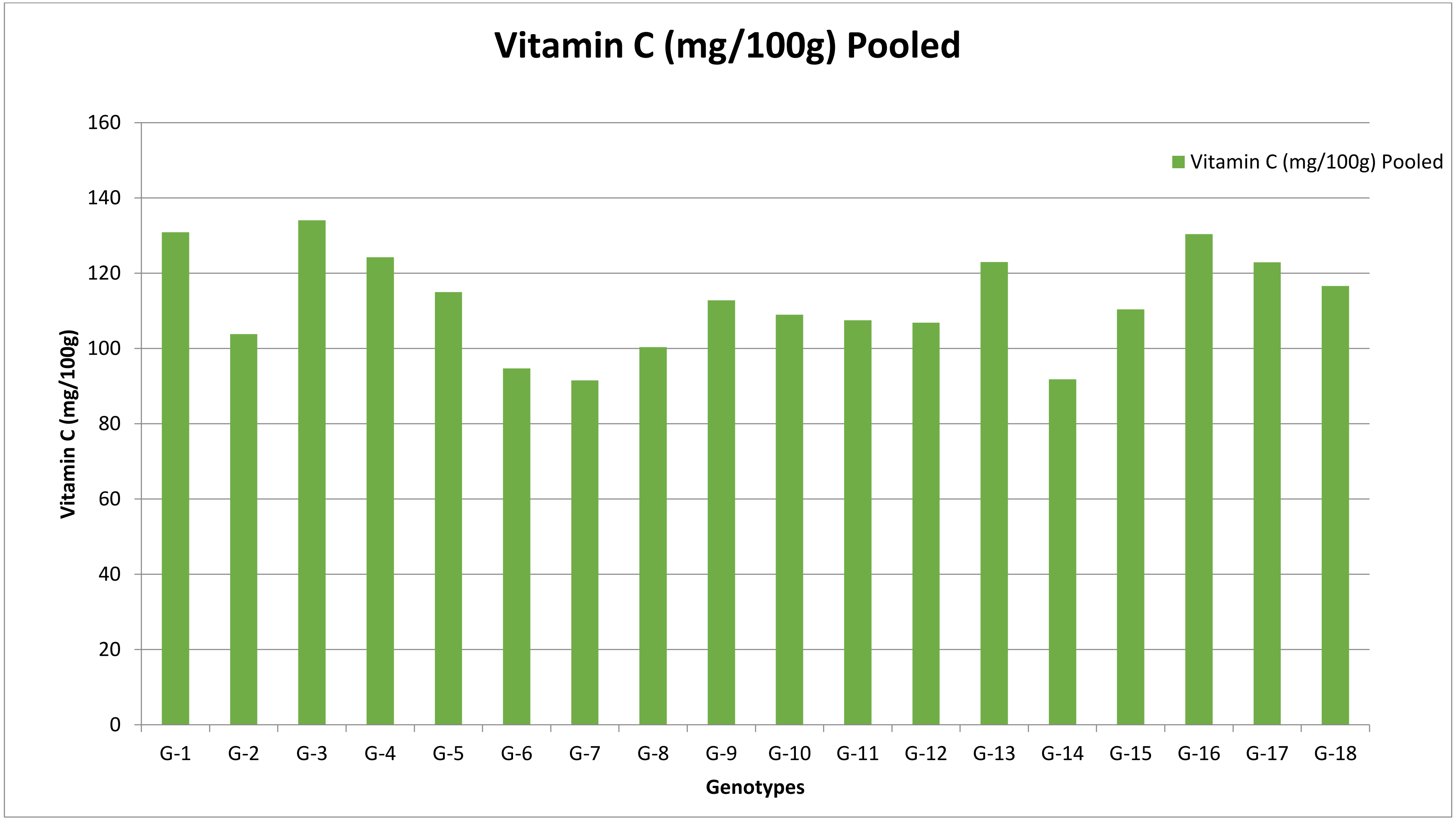


Fig 4.7: Vitamin C (mg/100g) of various colocasia genotypes

Table 4.13: Starch content (%) of colocasia genotypes

Starch content (%)			
Genotypes	**1st Year 2017**	**2nd Year 2018**	**Pooled**
Genotype -1	16.88	16.86	16.87
Genotype -2	11.32	11.32	11.32
Genotype -3	16.40	16.40	16.40
Genotype -4	13.44	13.42	13.43
Genotype -5	12.18	12.16	12.17
Genotype -6	13.68	13.68	13.68
Genotype -7	13.3	13.3	13.3
Genotype -8	10.53	10.51	10.52
Genotype -9	13.89	13.89	13.89
Genotype -10	14.32	14.33	14.31
Genotype -11	12.63	12.61	12.62
Genotype -12	14.67	14.65	14.66
Genotype -13	13.5	13.5	13.5
Genotype -14	11.77	11.75	11.76
Genotype -15	12.22	12.22	12.22
Genotype -16	15.03	15.03	15.03
Genotype -17	11.56	11.58	11.57
Genotype -18	10.99	10.99	10.99
Mean			13.23
C.V.			6.40
F ratio			13.20
S.E.			0.48
C.D. 5%			1.40
C.D. 1%			1.89
Range Lowest			10.52
Range Highest			16.87

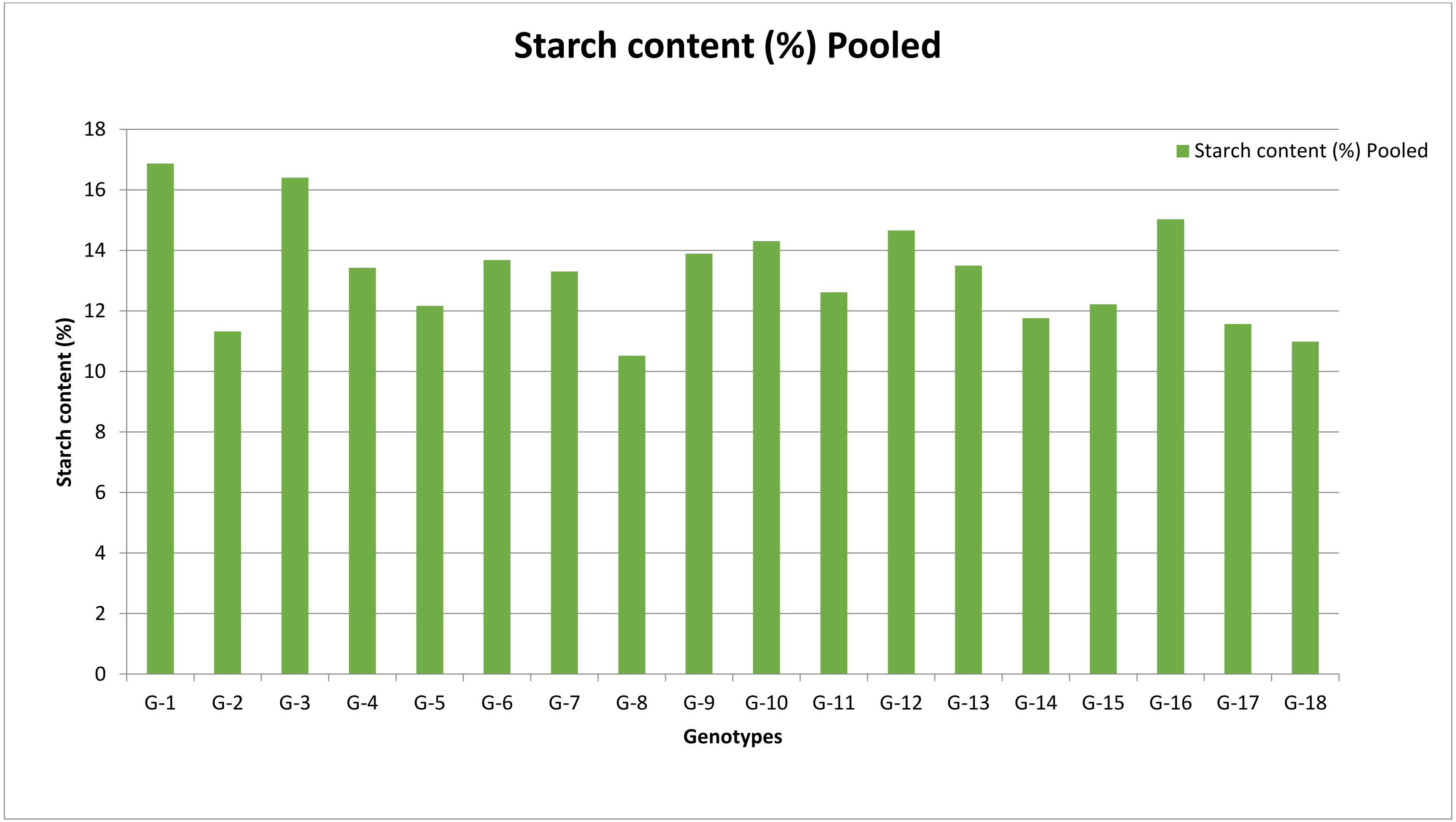


Fig 4.8: Starch content (%) of various colocasia genotypes

Table 4.14: Oxalic acid (%) of colocasia genotypes

Oxalic acid (%)			
Genotypes	**1st Year 2017**	**2nd Year 2018**	**Pooled**
Genotype -1	0.30	0.30	0.30
Genotype -2	0.53	0.51	0.52
Genotype -3	0.54	0.52	0.53
Genotype -4	0.42	0.42	0.42
Genotype -5	0.43	0.43	0.43
Genotype -6	0.62	0.63	0.61
Genotype -7	0.80	0.80	0.80
Genotype -8	0.59	0.57	0.58
Genotype -9	0.57	0.57	0.57
Genotype -10	0.47	0.47	0.47
Genotype -11	0.61	0.63	0.62
Genotype -12	0.64	0.62	0.63
Genotype -13	0.69	0.67	0.68
Genotype -14	0.67	0.67	0.67
Genotype -15	0.57	0.59	0.58
Genotype -16	0.83	0,83	0.83
Genotype -17	0.52	0.54	0.53
Genotype -18	0.62	0.64	0.63
Mean			0.58
C.V.			11.13
F ratio			11.90
S.E.			0.03
C.D. 5%			0.10
C.D. 1%			0.14
Range Lowest			0.30
Range Highest			0.83

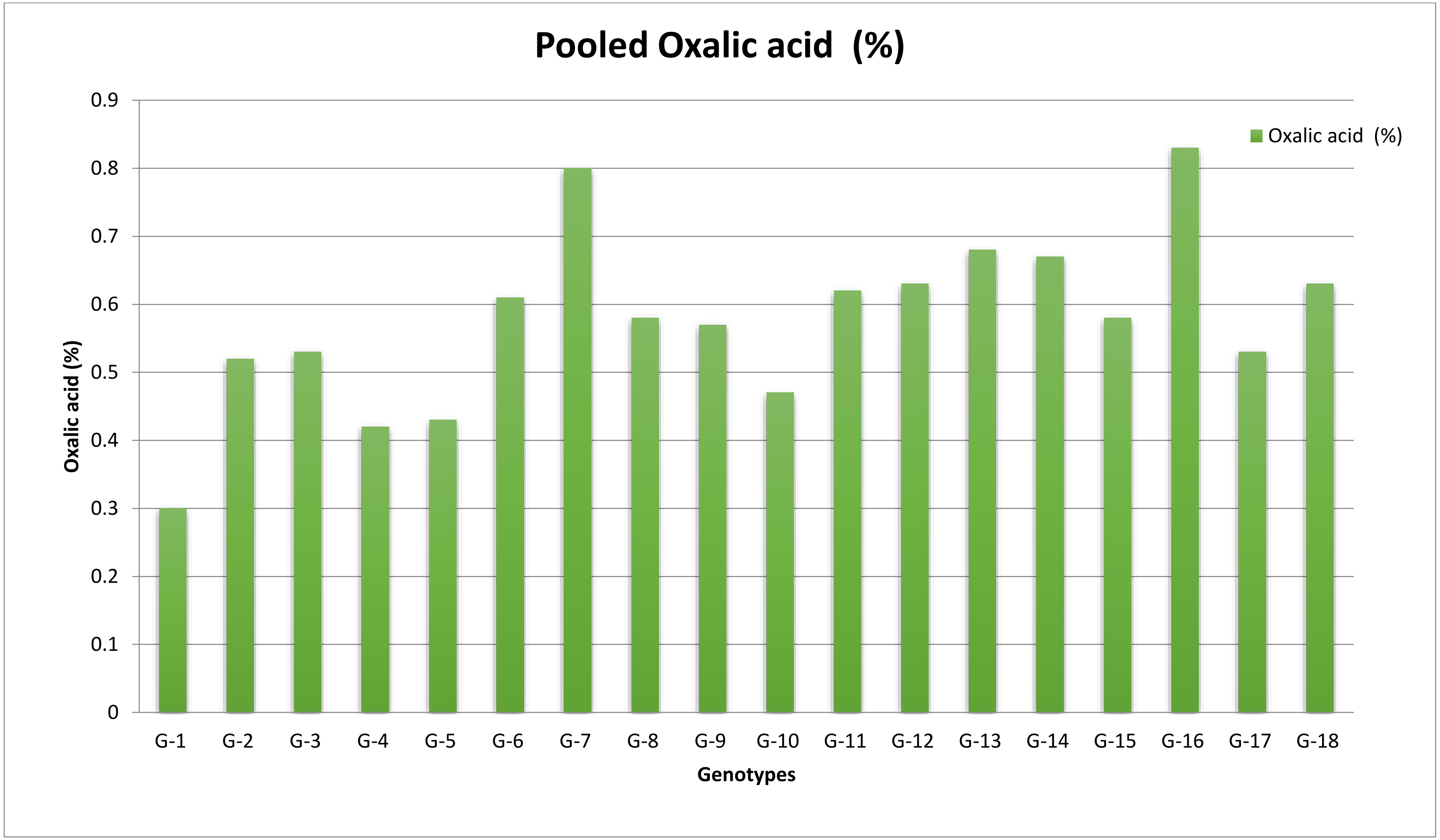


Fig 4.9: Oxalic acid (%) of various colocasia genotypes

4.1.4 Yield parameters

4.1.4.1 Number of corms per plant

The data regarding to number of corms per plant has been presented in the table 4.15 and fig 4.10. The maximum number of corms per plant was found in genotype 5 (2.42) followed by genotype 16 (2.31) and genotype 9 (2.22). Minimum number of corms per plant was found in genotype 18 (1.14).

The present investigation has reported significant difference in number of corm among the genotypes. Parallel results have been reported by Bhuiyan *et al.* (1989).

4.1.4.2 Number of cormels per plant

Table 4.16 and Figure 4.11 give the data regarding the number of cormels per plant. The maximum number of cormels per plant was found in genotype 16 (11.25) followed by genotype 9 (9.93) and genotype 13 (8.61). Minimum number of cormels per plant was found in genotype 10 (2.82).

The present investigation has reported significant difference in number of cormels, among the genotypes may primarily due accumulated storage foods, which have direct bearing on crop yield . Similar findings have been reported by Bhuiyan *et al*. (1989).

4.1.4.3 Weight of corm per plant (g)

The data pertaining to weight of corm per plant were shown in the table 4.17 and fig 4.12. The maximum weight of corm plant was found in genotype 1 (430.94 g) followed by genotype 3 (325.69 g) and genotype 5 (264.32 g). Minimum weight of corm per plant was found in genotype 18 (105.6 g).

The present investigation has shown that the weight of the corms is related to plant vigour, height. The genotype G-1 Nalon with the greatest corm weight, was observed to have vigourous plant health and plant height. This could be due to greater quantity of dry matter in the corm with higher yield adding characters. Parellel results were also reported by Akwee *et al*. (2015)

4.1.4.4 Weight of cormels per plant (g)

The data pertaining to weight of cormels per plant has been presented in the table 4.18 and fig 4.13. The maximum weight of cormels per plant was found in genotype 16 (363.89 g) followed by genotype 9 (323.63 g) and genotype 6 (298.16 g). Minimum weight of cormels per plant was found in genotype 18 (94.49 g).

The present investigation has shown that the weight of the cormels is also related to plant vigour, height, more number of cormels per plant etc. Genotype G-16 Eang was observed to have maximum number of cormels and hence higher cormel weight. This attribute has been observed to be very important because the main planting material in colocasia is the cormel. Therefore the quality of planting material is determined by the yield of the cormel. (Angami *et al*., 2019).

Table 4.15: Mean performance of colocasia genotypes for number of corms per plant

Genotypes	Number of corms per plant		
	1st year 2017	2nd year 2018	Pooled
Genotype -1	1.23	1.15	1.18
Genotype -2	1.20	1.26	1.23
Genotype -3	1.90	2.12	2.00
Genotype -4	2.16	2.18	2.17
Genotype -5	2.40	2.44	2.42
Genotype -6	1.60	1.62	1.61
Genotype -7	1.38	1.38	1.38
Genotype -8	1.52	1.54	1.53
Genotype -9	2.21	2.23	2.22
Genotype -10	1.28	1.36	1.32
Genotype -11	1.51	1.55	1.53
Genotype -12	1.24	1.26	1.25
Genotype -13	1.73	1.75	1.74
Genotype -14	1.30	1.37	1.33
Genotype -15	1.55	1.59	1.57
Genotype -16	2.3	2.33	2.31
Genotype -17	1.51	1.74	1.66
Genotype -18	1.11	1.17	1.14
Mean	1.63	1.64	1.64
C.V.	11.27	11.28	11.28
F ratio	14.82	14.83	14.83
S.E.	0.10	0.10	0.10
C.D. 5%	0.29	0.30	0.30
C.D. 1%	0.4	0.41	0.41
Range Lowest	1.13	1.14	1.14
Range Highest	2.41	2.42	2.42

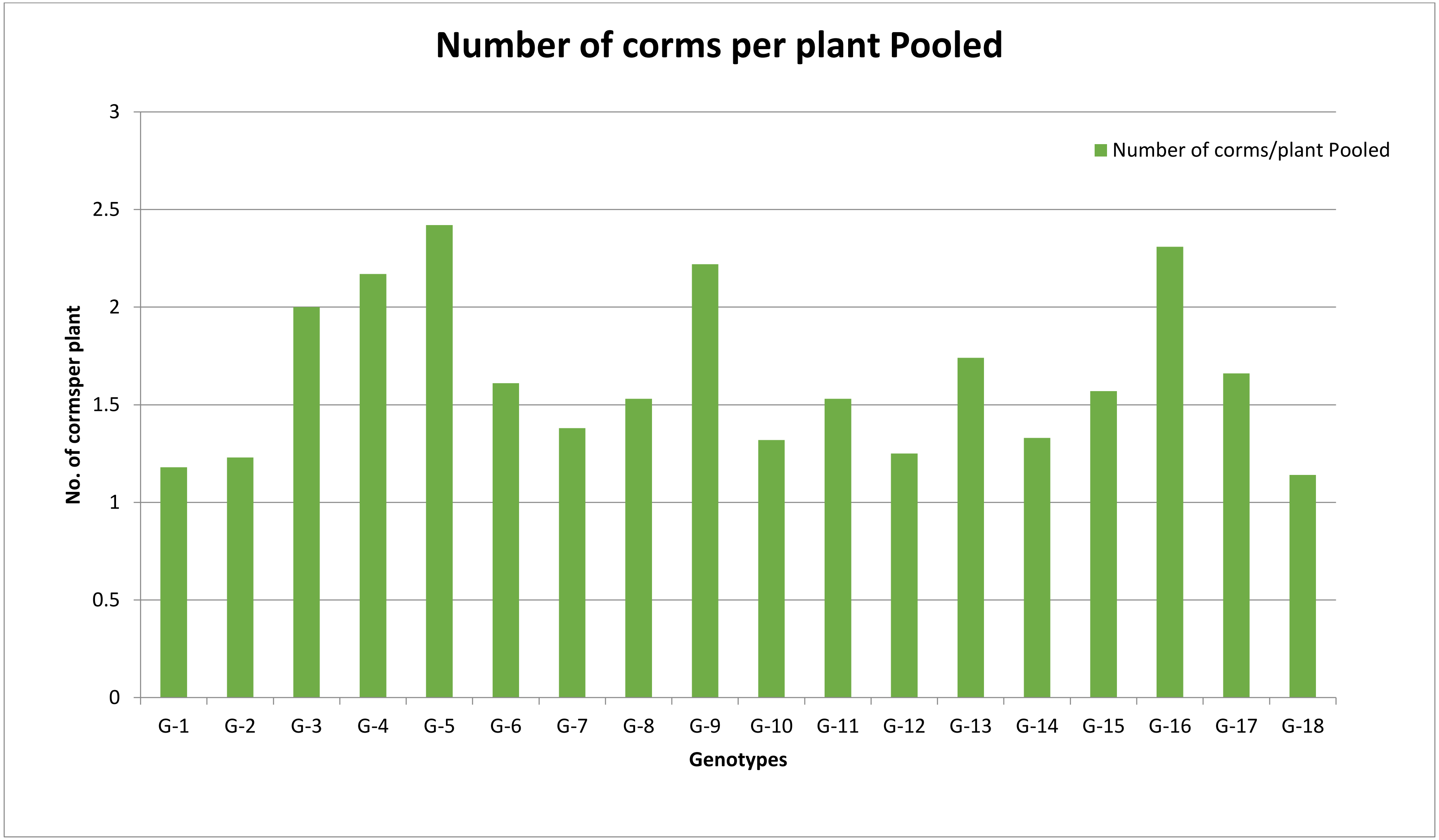


Fig 4.10: Number of corms per plant of various colocasia genotype

Table 4.16: Mean performance of colocasia genotypes for Number of cormels per plant

Genotypes	Number of Cormels per plant		
	1st year 2017	2nd year 2018	Pooled
Genotype -1	7.85	7.87	7.86
Genotype -2	4.46	4.49	4.48
Genotype -3	7.40	7.46	7.43
Genotype -4	7.81	7.89	7.85
Genotype -5	8.31	8.35	8.33
Genotype -6	7.55	7.57	7.56
Genotype -7	7.11	7.13	7.12
Genotype -8	6.62	6.62	6.62
Genotype -9	9.91	9.94	9.93
Genotype -10	2.80	2.84	2.82
Genotype -11	4.31	4.33	4.32
Genotype -12	7.21	7.25	7.23
Genotype -13	8.60	8.62	8.61
Genotype -14	5.98	6.08	6.03
Genotype -15	6.18	6.2	6.19
Genotype -16	11.26	11.24	11.25
Genotype -17	7.12	7.14	7.13
Genotype -18	3.32	3.96	3.64
Mean	6.9	6.91	6.91
C.V.	7.58	7.59	7.59
F ratio	49.21	49.22	49.22
S.E.	0.30	0.30	0.30
C.D. 5%	0.86	0.87	0.87
C.D. 1%	1.16	1.17	1.17
Range Lowest	2.81	2.82	2.82
Range Highest	11.24	11.25	11.25

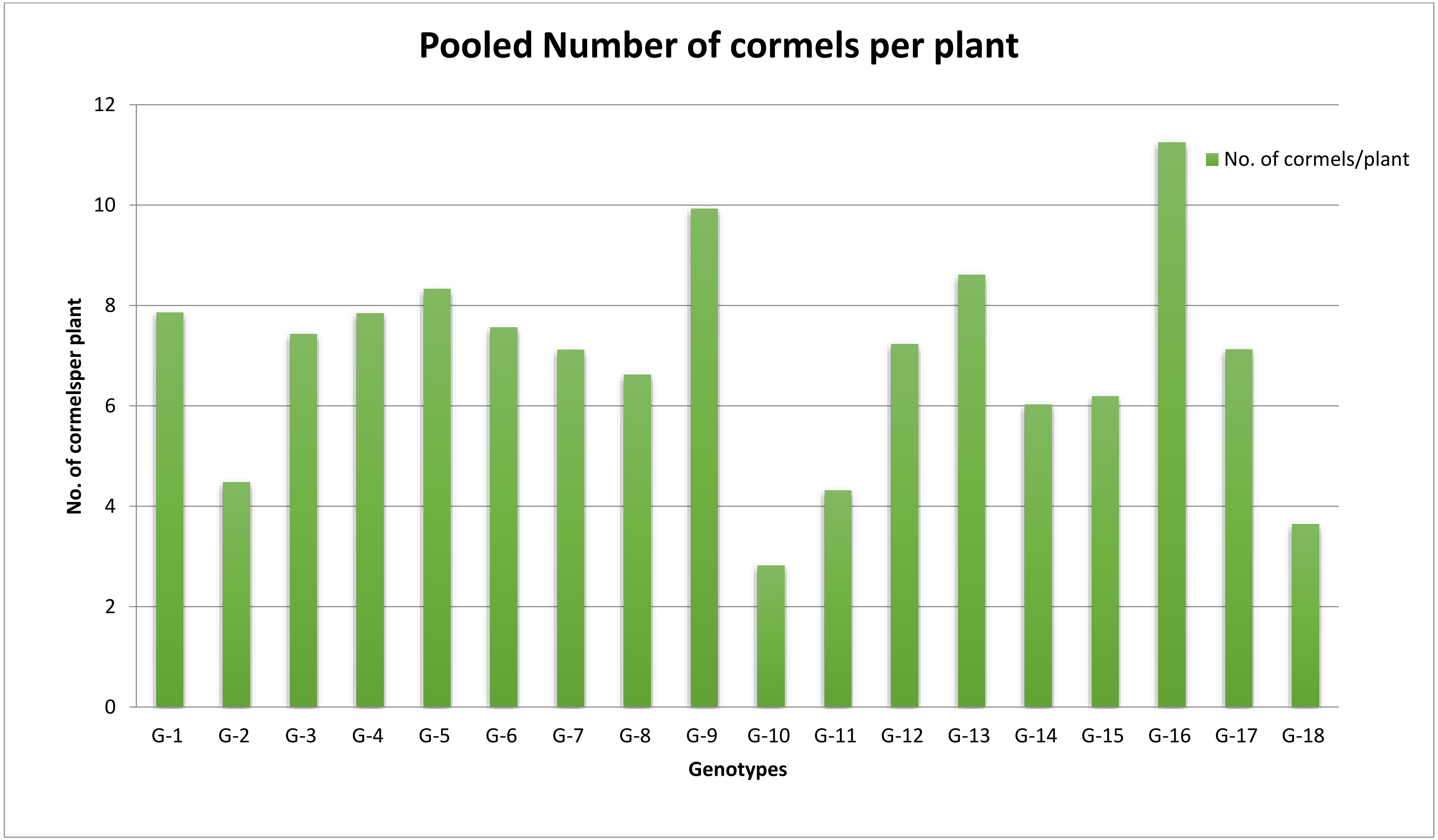


Fig 4.11: Number of cormels per plant of various colocasia genotypes

Table 4.17: Mean performance of colocasia genotypes for Weight of corm per plant (g)

Genotypes	Weight of corm per plant(g)		
	1st year 2017	2nd year 2018	Pooled
Genotype -1	430.84	431.04	430.94
Genotype -2	224.05	224.09	224.07
Genotype -3	325.68	325.7	325.69
Genotype -4	208.14	208.18	208.16
Genotype -5	262.33	266.35	264.32
Genotype -6	129.42	129.85	129.63
Genotype -7	172.17	172.57	172.37
Genotype -8	166.80	166.82	166.81
Genotype -9	163.90	163.94	163.92
Genotype -10	234.42	234.50	234.46
Genotype -11	121.79	121.99	121.89
Genotype -12	106.13	106.19	106.16
Genotype -13	157.80	157.88	157.84
Genotype -14	123.66	123.88	123.77
Genotype -15	123.37	125.37	124.37
Genotype -16	119.16	119.6	119.21
Genotype -17	163	163	163
Genotype -18	105.4	105.8	105.6
Mean	185.67	185.68	185.68
C.V.	7.22	7.23	7.23
F ratio	121.89	121.91	121.90
S.E.	7.74	7.75	7.75
C.D. 5%	22.27	22.29	22.28
C.D. 1%	29.9	29.92	29.91
Range Lowest	105.5	105.6	105.6
Range Highest	430.93	430.94	430.94

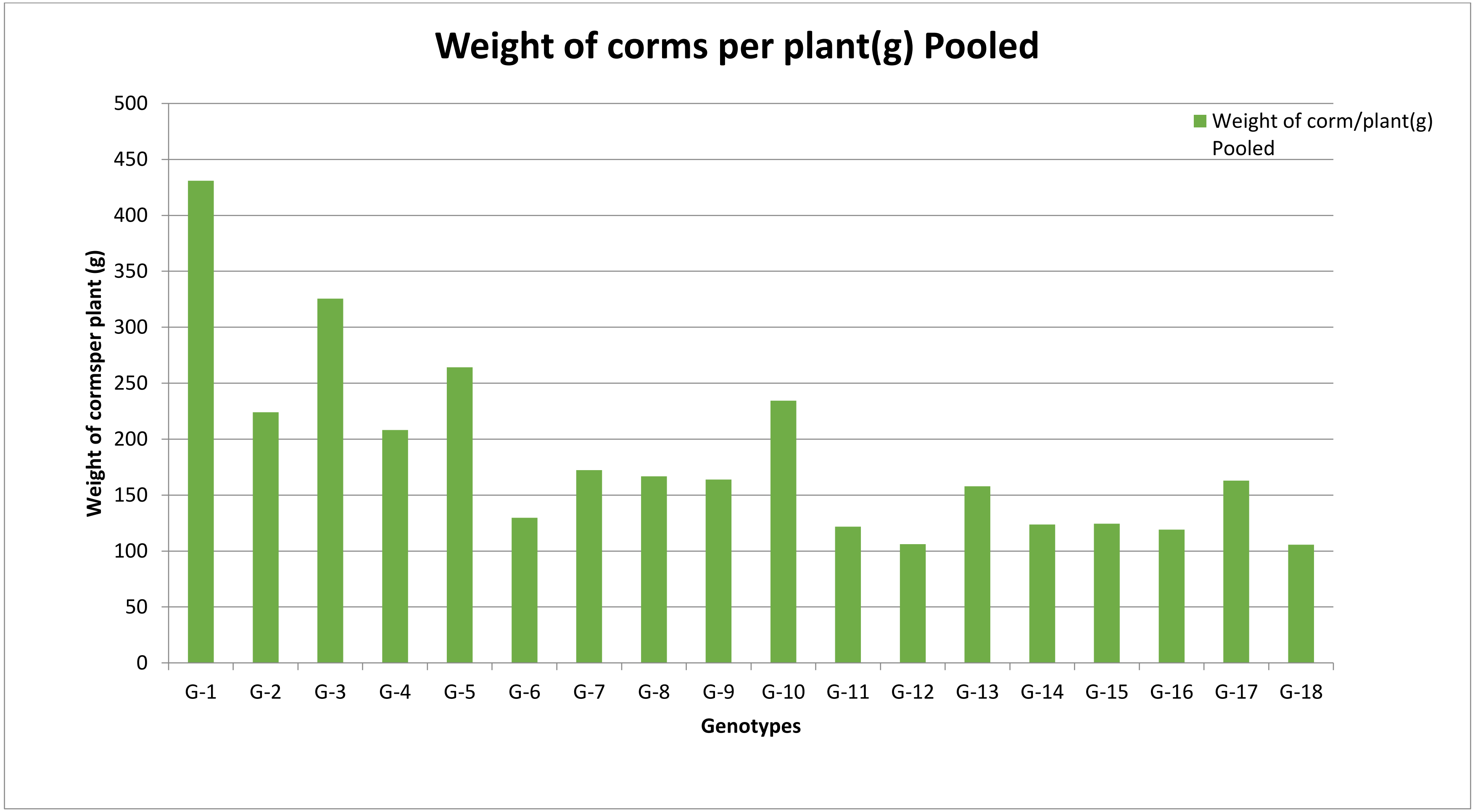


Fig 4.12: Weight of corms per plant (g) of various colocasia genotypes

Table 4.18: Mean performance of colocasia genotypes for Weight of cormels per plant (g)

Genotypes	Weight of cormels per plant(g)		
	1st year 2017	2nd year 2018	Pooled
Genotype -1	184.12	184.16	184.14
Genotype -2	139.83	139.85	139.84
Genotype -3	278.96	278.98	278.97
Genotype -4	265.55	265.57	265.56
Genotype -5	268.23	268.25	268.24
Genotype -6	298.15	298.17	298.16
Genotype -7	217.30	217.32	217.31
Genotype -8	209.61	209.65	209.63
Genotype -9	323.62	323.65	323.63
Genotype -10	129.81	129.83	129.82
Genotype -11	150.51	150.53	150.52
Genotype -12	260.45	265.26	262.84
Genotype -13	229.65	229.69	229.67
Genotype -14	219.23	219.25	219.24
Genotype -15	250.97	250.97	250.97
Genotype -16	363.87	363.91	363.89
Genotype -17	209	209	209
Genotype -18	94.47	94.51	94.49
Mean	227.54	227.55	227.55
C.V.	6.17	6.18	6.18
F ratio	74.73	74.74	74.74
S.E.	8.	8.12	8.12
C.D. 5%	23.35	23.37	23.36
C.D. 1%	31.35	31.36	31.36
Range Lowest	94.48	94.49	94.49
Range Highest	363.88	363.9	363.89

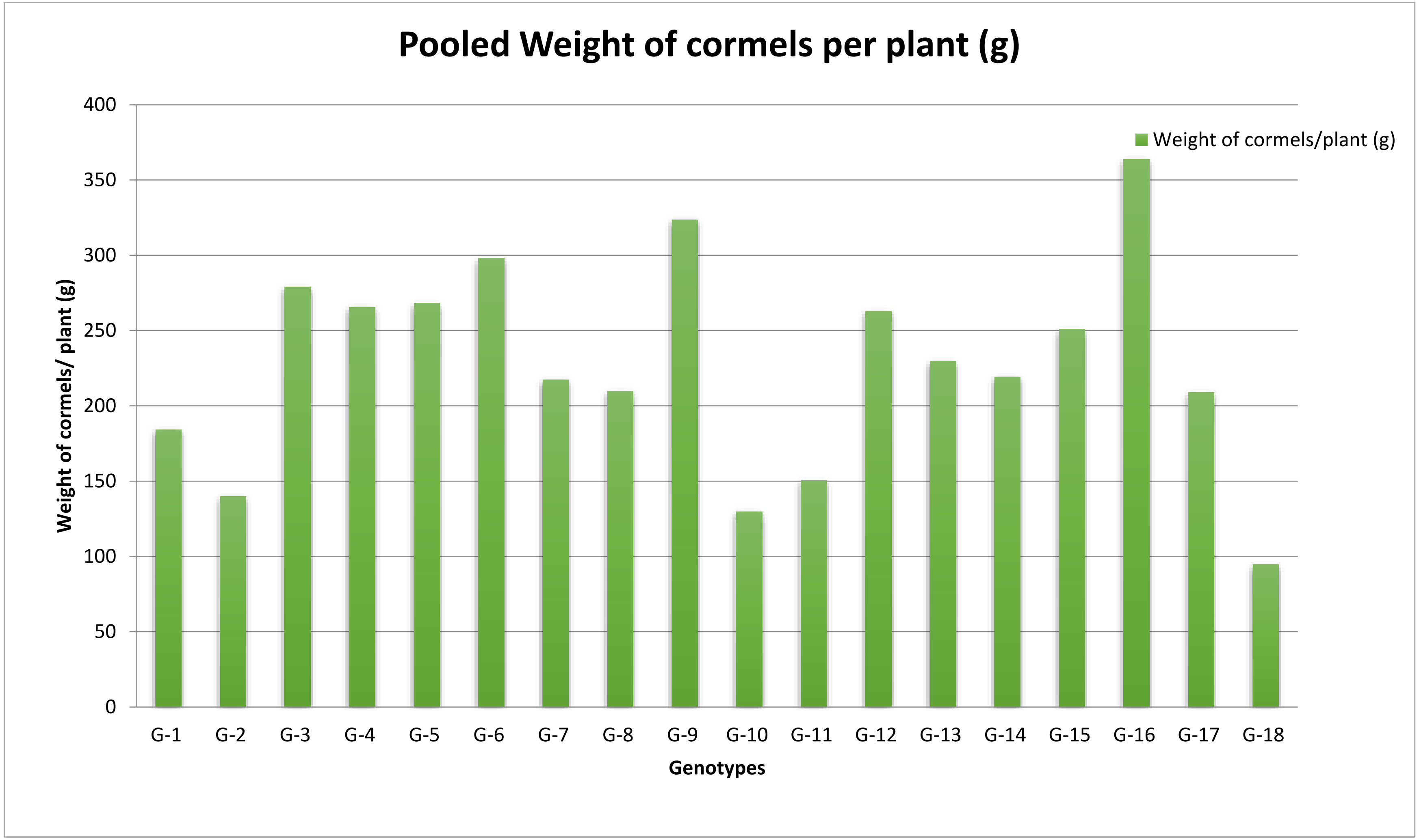


Fig 4.13: Weight of cormels per plant(g) of various colocasia genotypes

4.1.4.5 Yield per plot (Kg)

The yield per plot data is displayed in fig. 4.14 and table 4.19. The highest yield per plot was found in genotype 1 Nalon (12.93 kg) followed by genotype 3 Tomei (12.7 kg) and genotype 5 Tiru Baishi(11.01 kg). Minimum yield per plot was found in genotype 18 Tongshe (5.64 kg).

The present investigation reported that yield may have been affected by morphological characters like weight of corms and cormels and phenotypical characters such a plant height, number of suckers etc. (Akwee *et al*., 2015)

4.1.4.6 Yield per hectare (q)

The yield per hectare data is displayed in fig. 4.15 and table 4.20. The highest yield per hectare was found in genotype 1 (241.49 q) followed by genotype 3 (224.98 q) and genotype 5 (208.84 q). Minimum yield per hectare was found in genotype 18 (104.29 q). Similar findings were reported by Mitra *et al.* (2007), Mweye *et al.* (2010), Maninder *et al.* (2013), Dimbeshwar *et al.* (2014), Emmauel *et al.* (2014), Chinelo*et al.* (2015) and Karina *et al.* (2016) in colocasia.

Table 4.19: Mean performance of colocasia genotypes for yield per plot (kg)

Genotypes	Yield per plot(Kg)		
	1st year	2nd year	Pooled
Genotype -1	12.90	12.96	12.93
Genotype -2	8.45	8.55	8.50
Genotype -3	12.5	12.9	12.7
Genotype -4	10.76	10.82	10.79
Genotype -5	11.01	11.01	11.01
Genotype -6	10.49	10.51	10.50
Genotype -7	8.03	8.05	8.04
Genotype -8	7.51	7.61	7.56
Genotype -9	9.71	9.73	9.72
Genotype -10	9.3	9.7	9.5
Genotype -11	7.13	7.33	7.23
Genotype -12	8.69	8.79	8.74
Genotype -13	9.01	9.09	9.05
Genotype -14	7.12	7.4	7.18
Genotype -15	8.87	8.83	8.85
Genotype -16	7.3	7.5	7.4
Genotype -17	7.45	7.49	7.47
Genotype -18	5.63	5.65	5.64
Mean	9.03	9.04	9.04
C.V.	5.41	5.42	5.42
F ratio	47.79	47.8	47.80
S.E.	0.27	0.28	0.28
C.D. 5%	0.8	0.81	0.81
C.D. 1%	1.08	1.09	1.09
Range Lowest	5.62	5.64	5.64
Range Highest	12.91	12.93	12.93

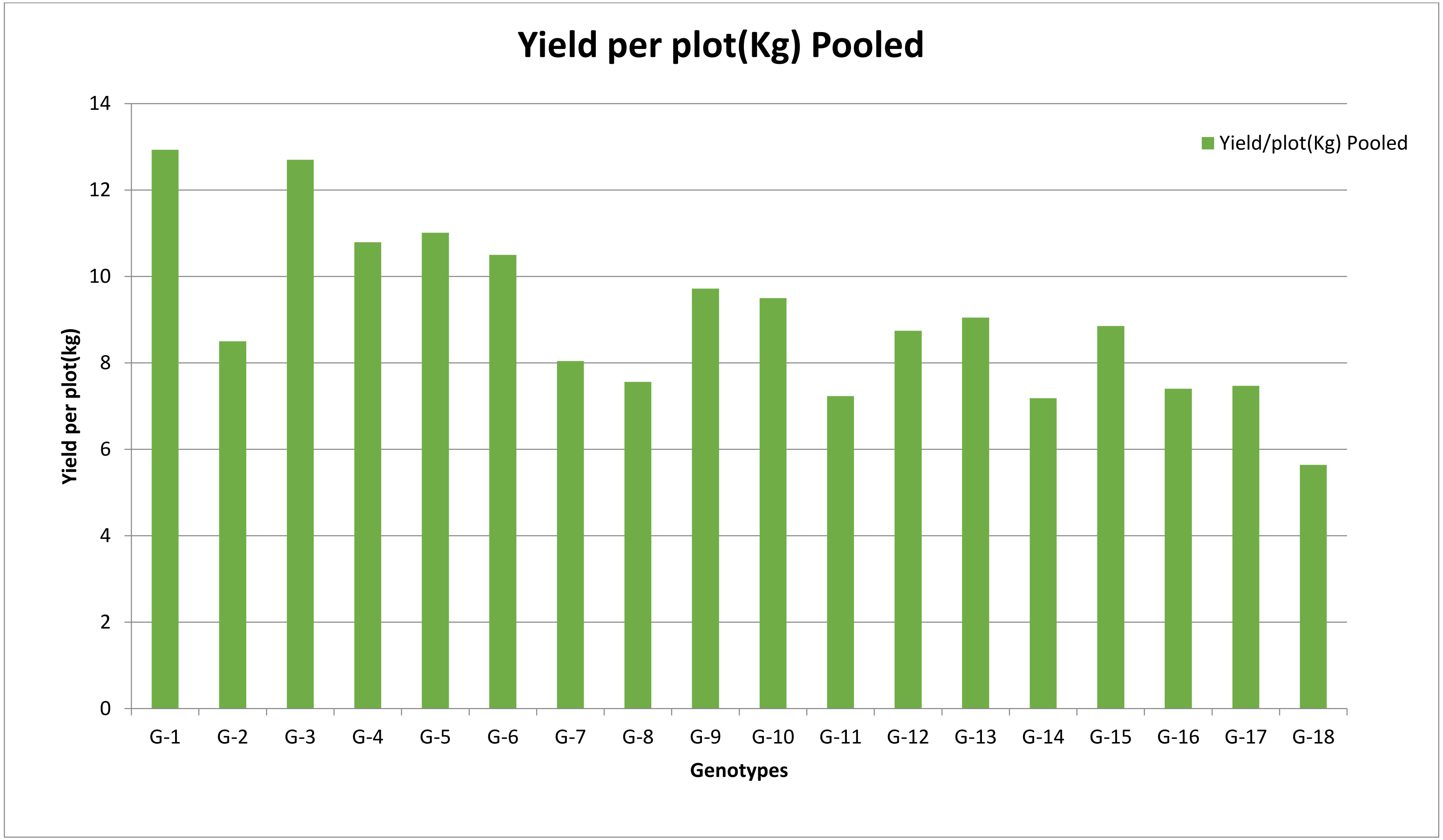


Fig 4.14: Yield per plot (Kg) of various colocasia genotypes

Table 4.20. Mean Performance of colocasia genotypes for yield per ha (q)

Genotypes	Yield per ha(q)		
	1st year	2nd year	Pooled
Genotype -1	241.45	241.53	241.49
Genotype -2	161.44	161.46	161.45
Genotype -3	224.97	224.99	224.98
Genotype -4	202.21	202.25	202.23
Genotype -5	208.82	208.86	208.84
Genotype -6	190.13	190.15	190.14
Genotype -7	148.53	148.55	148.54
Genotype -8	138.82	138.84	138.83
Genotype -9	178.77	178.81	178.79
Genotype -10	176.96	176.98	176.97
Genotype -11	145.38	145.40	145.39
Genotype -12	151.2	151.2	151.2
Genotype -13	152..57	152.59	152.58
Genotype -14	129.88	129.90	129.89
Genotype -15	153.12	153.16	153.14
Genotype -16	147.95	147.97	147.96
Genotype -17	134.44	134.46	134.45
Genotype -18	104.28	104.3	104.29
Mean	166.16	166.17	166.17
C.V.	5.12	5.14	5.14
F ratio	52.26	52.28	52.27
S.E.	4.91	4.94	4.93
C.D. 5%	4.18	4.19	14.19
C.D. 1%	19.03	19.06	19.05
Range Lowest	104.27	104.29	104.29
Range Highest	241.48	241.49	241.49

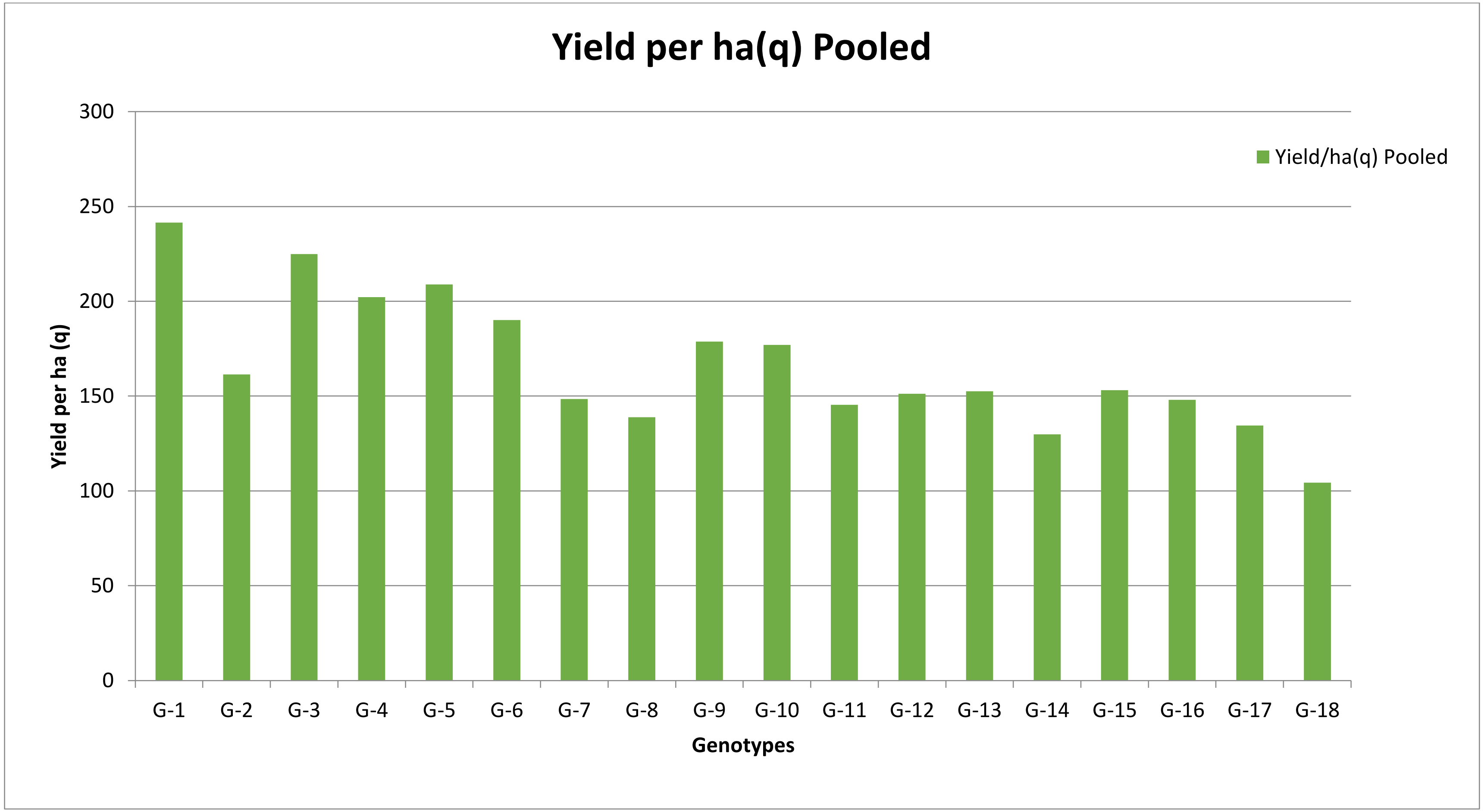


Fig 4.15: Yield per ha (q) of various colocasia genotypes

4.2. BIOMETRICAL ANALYSIS

4.2.1 Estimation of coefficients of variation

The component of variation such as genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were computed. It is essential to know about the selection by separating out the environmental influences from total variability. This shows how accurately a genotype can be determined based on its phenotypic performance. Genotypic and phenotypic coefficient of variation are simple measure of variability, these measures are commonly used for the assessment of variability. The comparative value of these types of coefficients gives knowledge about the magnitude of variability present in genetic population. Thus, the component of variation such as genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were compared. The phenotypic coefficient of variation was slightly more than the corresponding genotypic coefficient of variation showed the impact of environment in the expression of the character under study.

Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) are categorized as low (less than 10%), moderate (10-20%) and high (more than 20%) as recommended by Sivasubramanian and Madhavamenon (1973).

Phenotypic and genotypic coefficients of variation of various characters are displayed in table 4.21. High magnitude of phenotypic as well as genotypic coefficient of variations were recorded for traits *viz.* weight of corm per plant (46.48% and 45.91%), number of cormels per plant (31.40% and 30.47%), weight of cormel per plant (31.29% and 30.68%), number of suckers per plant (29.13% and 27.88%), number of leaves (28.32% and 27.32%), number of corm (26.72% and 24.22%), LAI (24.66% and 20.24%), oxalic acid (23.97% and 21.23%), yield per plot (22.11% and 21.44%), plant height (22.06% and 21.26%) and yield per hectare (21.90% and 21.28%). This high value of PCV and GCV indicated that higher variability exists in these characters and there is enough scope for further improvement. Parellel similar were also reported earlier Vinutha *et al.* (2015), Pratibha *et al.* (2013) and Juri *et al.* (2013)

Moderate PCV and GCV were recorded for suggested existence of considerable variability in the population *viz.* moisture content (15.92% and 14.89%), Vitamin C (15.04% and 9.73%), protein (14.9% and 13.66%) and starch (14.43% and 12.93%). Selection for these characters may also be given the importance for improvement programme. Vinutha *et al.* (2015) and Juri *et al.* (2013) reported similar findings in colocasia.

Phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the traits indicating that environmental factors were influencing the expression of traits. Narrow difference between phenotypic and genotypic coefficient of variations indicated less environmental interference on the expression of these traits. The characters which showed high phenotypic and genotypic coefficient of variations are of economic importance and there is scope for improvement of these traits through selection.

4.2.2 Heritability (h^2_{bs}) and Genetic advance (GA)

While genetic advancement provided the knowledge about projected gain for a given feature following selection, heritability controlled the likeness between parents and their offspring. Heritability serves as an indicator of a trait's transmissibility to its offspring and implies the relative contribution of genetic factors to the expression of phenotypes. However, the knowledge of heritability alone does not help to formulate a concrete breeding programme, genetic advance along with heritability help to ascertain the possible genetic control for any particular trait. An important factor in determining the degree of improvement of any creptoid species is the type and degree of a genotype's innate capacity for a character. The key genetic factors for choosing a genotype that allow for increased selectivity by separating environmental influence from total variability are heritability and genetic advancement.

Heritability estimates provides the information regarding the amount of transmissible genetic variation to total variation and determine genetic improvement and response to selection. Heritability estimates along genetic advance are normally more useful in predicting the gain under selection than that of heritability alone. However it is not necessary that a character showing high heritability will also exhibit high genetic advance. The heritability usually considered to be low if it is less than 30%, moderate between (30%-60%) and high heritability if it is more than 60% (Johnson *et al.* 1955). Heritability estimates provides the information regarding the amount of transmissible genetic variation to total variation and determine genetic improvement and response to selection. Heritability estimates along genetic advance are normally more useful in predicting the gain under selection than that of heritability alone.

Among the thirteen characters estimated in this experiment all the character have shown heritability above 60% in which the highest heritability in broad sense was observed in weight of corm per plant (97.6%) followed by Weight of cormel per plant (96.1%) and yield per ha (94.5%) as shown in the table 4.22.

The heritability value alone however, provides no indication of the amount of genetic improvement that would result from selection of superior genotypes. To facilitate the comparison of progress in various characters of different genotypes, genetic advance was calculated as percentage of mean. The range of genetic advance was calculated as percentage of mean. The range of genetic advance as percent of mean is classified as low if it is less than 10%, moderate between (10-20%) and high if more than 20% (Johnson *et al.* 1955)

Genetic advance as percentage of mean was observed highest for weight of corm per plant (93.42%) followed by weight of cormel per plant (61.95%), number of cormel per plant (60.90%), number of suckers (54.96%), number of leaves (54.29%), number of corm (45.24%), yield per plot (42.81%), yield per hectare (42.61%), plant height (42.29%), oxalic acid (38.72%), LAI (34.21%), moisture (28.69%), protein (25.77%) and starch (23.86%) have shown high genetic advance. Moreover, Vitamin C (12.98%) have shown moderate genetic advance. The high value of genetic advance for these traits showed that these characters are governed by additive genes and selection will be rewarding for improvement of these traits. Moderate genetic advance for the traits suggest that both the additive and non-additive variance are operating in these traits. The results were in conformity with Vinutha *et al.* (2015), Pratibha *et al.* (2013) and Juri *et al.* (2013) in colocasia

Heritability estimates along with genetic advance are more useful than the heritability value alone for selecting the best individual. In present experiment it is found that almost all the characters are showing high heritability also high genetic advance except number of leaves and girth of mother rhizome indicating that most likely the heritability is due to additive gene effects and selection may be effective.

Table 4.21. Genetic Parameters genotypic and phenotypic coefficient of variation

S.V	Plant Height	No. of leaves	LAI	No. of suckers/ plant	No. of corms/ plant	No. of cormels/ plant	Wt. of corm/ plant(g)	Wt. of cormels/ plant(g)	Moisture (%)	Protein (%)	Vit. C (mg/100g)	Starch content	Oxalic acid	Yield/ plot(Kg)	Yield/ha(q)
ECV	5.738	7.457	14.097	8.455	11.28	7.6	7.231	6.187	5.636	6	11.465	6.409	11.135	5.427	5.148
GCV	21.263	27.317	20.239	27.879	24.224	30.471	45.909	30.676	14.89	13.664	9.734	12.928	21.227	21.437	21.282
PCV	22.023	28.317	24.664	29.133	26.722	31.404	46.475	31.293	15.921	14.923	15.04	14.429	23.97	22.113	21.896
h^2 (Broad Sense)	93.2	93.1	67.3	91.6	82.2	94.1	97.6	96.1	87.5	83.8	41.9	80.3	78.4	94	94.5
Genetic Advancement 5%	30.173	7.62	0.07	2.299	0.745	4.211	173.465	140.958	20.553	0.544	14.606	3.159	0.225	3.874	70.812
Genetic Advancement 1%	38.669	9.765	0.089	2.946	0.955	5.397	222.304	180.645	26.34	0.697	18.718	4.048	0.288	4.964	90.749
Gen.Adv as % of Mean 5%	42.288	54.287	34.21	54.958	45.238	60.904	93.42	61.945	28.688	25.773	12.978	23.86	38.723	42.809	42.612
Gen.Adv as % of Mean 1%	54.194	69.572	43.842	70.432	57.975	78.052	119.723	79.385	36.765	33.029	16.632	30.578	49.625	54.863	54.61
General Mean	71.352	14.036	0.204	4.182	1.647	6.914	185.682	227.555	71.645	2.111	112.54	13.239	0.581	9.048	166.178
Exp Mean next Generation	101.525	21.656	0.274	6.481	2.392	11.126	359.146	368.513	92.198	2.656	127.145	16.398	0.805	12.922	236.99

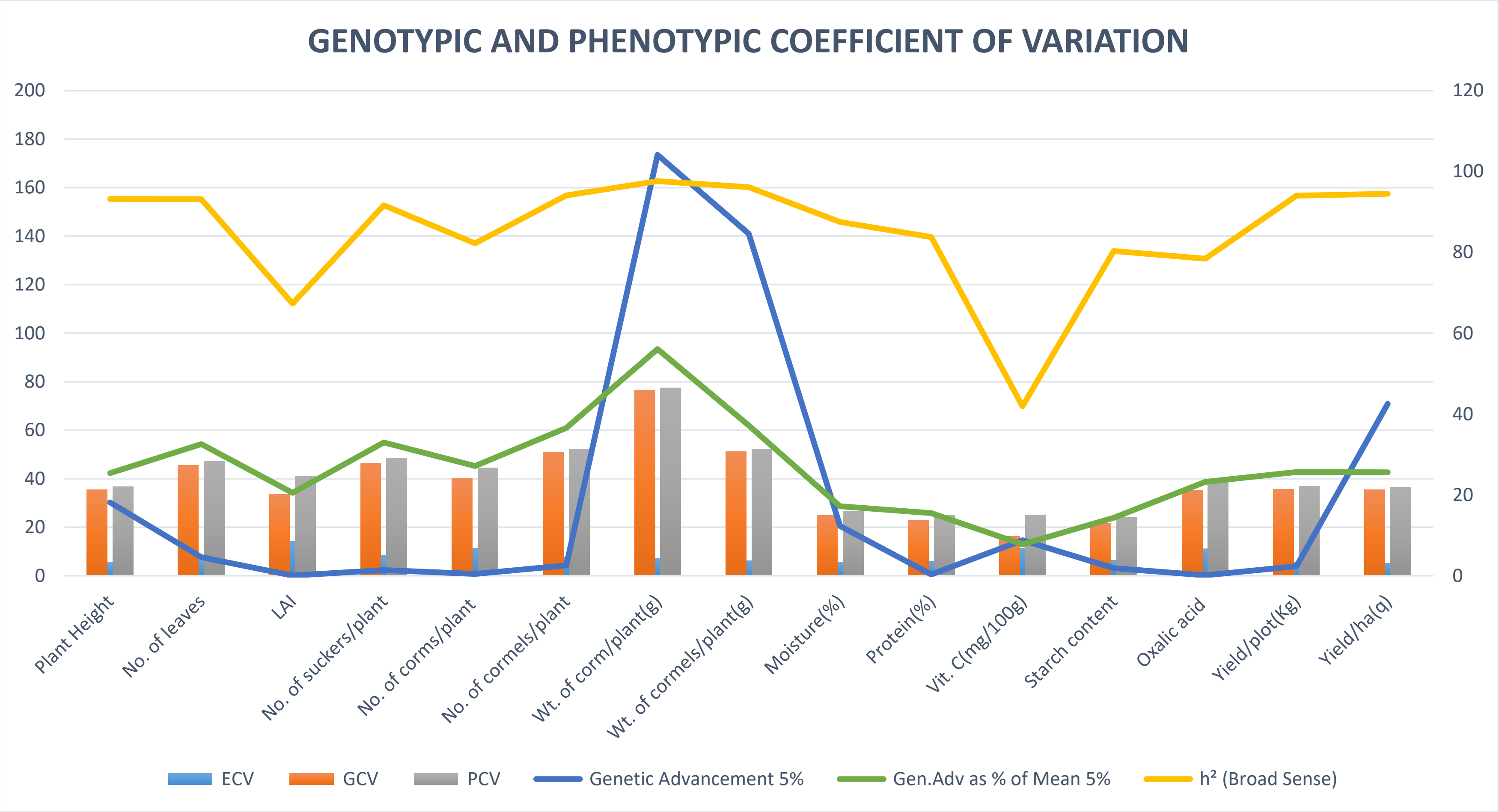


Fig. No. 4.16:Genotypic and phenotypic coefficient of variation

Table 4.22: Genetic parameters of yield and its component characters in colocasia

Sl. No.	Characters	Mean$\pm$SE(m)	Range		Coefficient of variability (%)		Heritability (h^2)	Genetic Advance as % of mean (Genetic gain)
			Min.	Max.	PCV	GCV		
1	Plant height	71.35	47.24	98.43	22.02	21.26	93.2 %	42.29
2	Number of leaves	14.04	6.06	21.11	28.32	27.32	93.1%	54.29
3	LAI	0.20	0.13	0.28	24.66	20.24	67.3%	34.21
4	No of suckers per plant	4.18	2.06	6.11	29.13	27.88	91.6%	54.96
5	No. of corms per plant	1.65	1.14	2.42	26.72	24.22	82.2%	45.24
6	No of cormels/plant	6.91	2.82	11.25	31.40	30.47	94.1%	60.90
7	Wt. of corm/plant(g)	185.68	105.6	430.94	46.48	45.91	97.6%	93.42
8	Wt. of cormels/plant(g)	227.56	94.49	363.89	31.29	30.68	96.1%	61.95
9	Moisture (%)	71.65	48.61	84.46	15.92	14.89	87.5%	28.69
10	Protein (%)	2.11	1.23	2.44	14.92	13.66	83.8%	25.77
11	Vit. C (mg/100g)	112.5	91.52	134.04	15.04	9.73	41.9%	12.98
12	Starch content (%)	13.24	10.52	16.87	14.43	12.93	80.3%	23.86
13	Oxalic acid (%)	0.58	0.30	0.83	23.97	21.23	78.4%	38.72
14	Yield/plot (Kg)	9.05	5.64	12.93	22.11	21.44	94%	42.81
15	Yield/ha (q)	166.18	104.29	241.49	21.90	21.28	94.5%	42.61

4.2.3 Correlation studies

The phenotypic and genotypic correlation coefficients among different characters were worked out in all possible combinations (Table 4.23 and 4.24). In general, it was observed that genotypic correlation coefficient (r_g) values were higher in magnitude than the phenotypic correlation coefficient (r_p) values.

Plant height showed positive and significant correlation with LAI (0.72), Number of suckers (0.49) and negative and significant correlation with number of cormels (-0.56), weight of cormels per plant (-0.56) at phenotypic level. Plant height also showed positive and significant correlation with number of leaves (0.32), LAI (0.91), number of suckers (0.51), weight of corm (0.32) and negative and significant correlation with number of cormels (-0.60), weight of cormels (-0.58), protein (-0.44), oxalic acid (-0.35) at genotypic level.

Number of leaves showed positive and significant correlation with number of suckers (0.81), weight of corm per plant (0.45), Starch (0.46), yield per ha (0.56) at phenotypic level and positive significant correlation with plant height (0.32), number of suckers (0.86), number of corm (0.27), number of cormels (0.30), weight of corm (0.47), weight of cormels (0.33), protein (0.32), starch (0.53) and yield per ha (0.52) at genotypic level.

Leaf Area Index (LAI) showed positive and significant correlation with plant height (0.72) and negative and significant correlation with weight of cormels per plant (-0.50), protein (-0.44) at phenotypic level. LAI also showed positive and significant correlation with plant height (0.91), number of suckers (0.39), weight of corm (0.48), moisture (0.30) and negative significant correlation with number of cormels per plant (-0.43), weight of cormels per plant (-0.62), protein (-0.57), oxalic acid (-0.48) at genotypic level.

Number of suckers per plant showed positive and significant correlation with plant height (0.49), number of leaves (0.81) at phenotypic level. number of suckers per plant also showed positive and significant correlation with plant height (0.51), number of leaves (0.86), LAI (0.39) weight of corm (0.30), Starch (0.33) and negative correlation with Vitamin C (-0.34) at genotypic level.

Number of corms per plant showed positive and significant correlation with number of cormels (0.64), weight of cormels (0.71), yield per ha (0.37) at phenotypic level. Number of corms per plant also showed positive and significant correlation with number of leaves (0.27), number of cormels (0.73), weight of cormels (0.77), protein (0.34), Vitamin C (0.53), Starch (0.33), yield per ha (0.39) at genotypic level.

Number of cormels per plant showed positive and significant correlation with number of corms (0.64), weight of cormels (0.87), yield per ha (0.31) and negative correlation with plant height (-0.56) at phenotypic level. Number of cormels per plant also showed positive and significant correlation with number of leaves (0.30), number of corm (0.73), weight of cormels (0.90), protein (0.48), starch (0.45), yield (0.33) and negative correlation with plant height (-0.60), LAI (-0.43) at genotypic level.

Weight of corm per plant showed positive and significant correlation with number of leaves (0.45), starch (0.49), yield per ha (0.80) and negative correlation with oxalic acid (-0.64) at phenotypic level. Weight of corm per plant showed positive and significant correlation with plant height (0.32), Number of leaves (0.47), LAI (0.48), number of suckers (0.30), moisture (0.30), protein (0.36), Ascorbic acid (Vitamin C) (0.43), starch (0.58), yield per ha (0.85) and negative correlation with oxalic acid (-0.84) at genotypic level.

Weight of cormels per plant showed positive and significant correlation with number of corms (0.71), number of cormels (0.87), protein (0.47), yield (0.30) and negative correlation with plant height (-0.56), LAI (-0.50) at phenotypic level. Weight of cormels per plant also showed positive and significant correlation with number of leaves (0.33), number of corm (0.77), number of cormels (0.90), protein (0.52), starch (0.39), yield (0.30) and negative correlation plant height (-0.58), LAI (-0.62) at genotypic level.

Moisture showed positive and significant correlation with yield per ha (0.31) at phenotypic level. Moisture also showed positive and significant correlation with LAI (0.30), weight of corm (0.28), starch (0.40), yield per ha (0.37) and negative and significant correlation with oxalic acid (-0.33) at genotypic level.

Protein showed positive and significant correlation with weight of cormel (0.47), starch (0.50), yield (0.48) and negative correlation with LAI (-0.44) at phenotypic level. Protein showed positive and significant correlation with number of leaves (0.32), number of corm (0.34), number of cormels (0.48), weight of corm (0.36), weight of cormels (0.52), starch (0.63), yield per ha (0.51) and negative correlation with plant height (-0.44), LAI (-0.57) at genotypic level.

Ascorbic acid (Vitamin C) showed positive and significant correlation with number of corm (0.53), weight of corm (0.43), starch (0.37), yield per ha (0.30) and negative and significant correlation with number of suckers (-0.34), oxalic acid (-0.50) at genotypic level.

Starch content showed positive and significant correlation with number of leaves (0.46), weight of corm (0.49), protein (0.50) at phenotypic level. Starch content also showed positive and significant correlation with number of leaves (0.53), number of suckers (0.39), number of corm (0.33), number of cormel (0.45), weight of corm (0.58), weight of cormel (0.39), moisture (0.40), protein (0.63), Vitamin C (0.37), yield per ha (0.72) and negative and significant correlation with oxalic acid (-0.27) at genotypic level.

Oxalic acid showed negative and significant correlation with weight of cormels (-0.73) at phenotypic level. Oxalic acid also showed negative and significant correlation with plant height (-0.35), LAI (-0.48), weight of corm (-

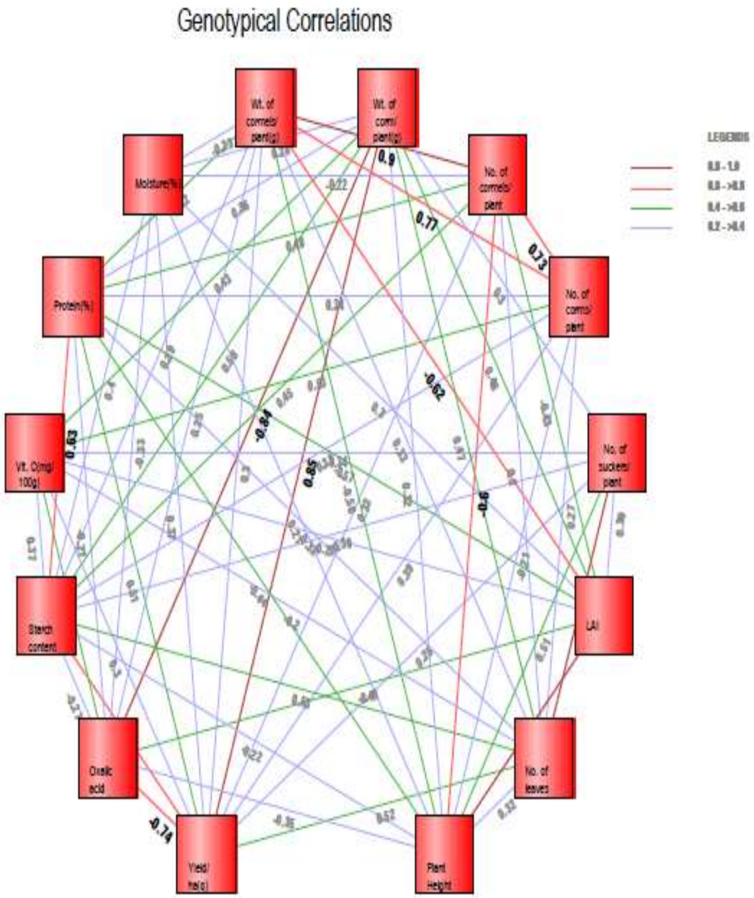
0.84), moisture (-0.33), Vitamin C (-0.50), starch (-0.27), yield per ha (-0.79) at genotypic level.

Yield per hectare showed positive and significant correlation with number. of leaves (0.50), number of corm (0.37), number of cormels (0.31), weight of corm (0.80), weight of cormels (0.30), moisture (0.31), protein (0.45), starch (0.65) and negative and significant correlation with oxalic acid (-0.64) at phenotypic level. Yield per hectare showed positive and significant correlation with number of leaves (0.52), number of corm (0.39), number of cormels (0.33), weight of corm (0.85), weight of cormels (0.30), moisture (0.37), protein (0.51), Viamin C (0.30), starch (0.72) and negative and significant correlation with oxalic acid (-0.74) at genotypic level.

These findings were in conformity with Orji and Ogbonna (2015), Pranabjyoti (2007) and Vellayudhan *et al.* (2000) in colocasia.

Table 4.23: Genotypical correlation coefficient (r_g) between 13 characters of colocasia

Genotypic Correlation Studies														
Traits	**Plant height**	**No. of leaves**	**LAI**	**No. of suckers/plant**	**No. of corms/plant**	**No. of cormels/plant**	**Wt. of corm/plant(g)**	**Wt. of cormels/plant(g)**	**Moisture (%)**	**Protein (%)**	**Vit. C (mg/100g)**	**Starch content (%)**	**Oxalic acid (%)**	**Yield/ha(q)**
Plant height	**1**	0.32***	0.91***	0.51***	-0.21	-0.60***	0.32***	-0.58***	0.21	-0.44***	-0.10	-0.22	-0.35***	**0.04**
No. of leaves		**1**	0.14	0.86***	0.27***	0.30***	0.47***	0.33***	0.05	0.32***	-0.20	0.53***	-0.15	**0.52*** **
LAI			**1**	0.39***	-0.18	-0.43***	0.48***	-0.62***	0.30***	-0.57***	0.23	-0.14	-0.48***	**0.10**
No. of suckers/plant				**1**	0.11	0.09	0.30***	0.10	0.11	-0.05	-0.34***	0.39***	-0.03	**0.25**
No. of corms/plant					**1**	0.73***	0.10	0.77***	-0.13	0.34***	0.53***	0.33***	0.02	**0.39*** **
No. of cormels/plant						**1**	0.09	0.90***	-0.22	0.48***	0.19	0.45***	0.20	**0.33*** **
Wt. of corm/plant(g)							**1**	-0.12	0.28***	0.36***	0.43***	0.58***	-0.84***	**0.85*** **
Wt. of cormels/plant(g)								**1**	-0.23	0.52***	-0.03	0.39***	0.25	**0.30*** **
Moisture (%)									**1**	-0.02	0.11	0.40***	-0.33***	**0.37*** **
Protein (%)										**1**	0.17	0.63***	-0.21	**0.51*** **
Vit. C (mg/100g)											**1**	0.37***	-0.50***	**0.30*** **
Starch content (%)												**1**	-0.27***	**0.72*** **
Oxalic acid (%)													1	**-0.74*** **



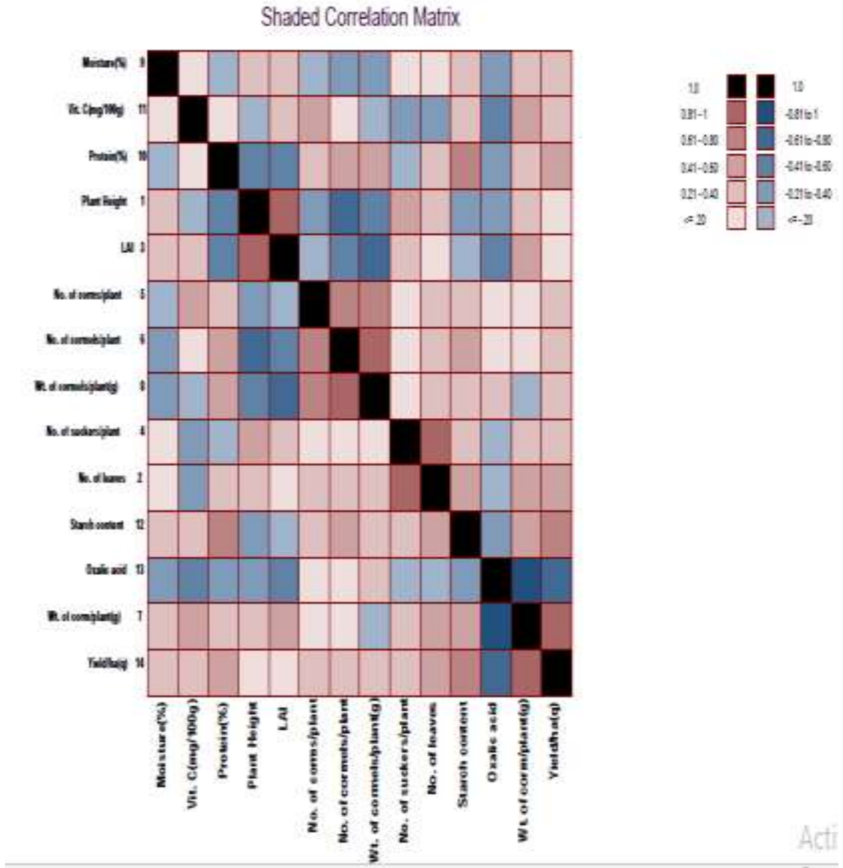


Fig 4.17: Genotypical correlations

Fig 4.18: Shaded Correlation matrix (Genotypic)

Table 4.24: Phenotypical correlation coefficient (r_p) between 13 characters of colocasia

Phenotypic Correlation Studies														
Traits	**Plant height**	**No. of leaves**	**LAI**	**No. of suckers/plant**	**No. of corms/plant**	**No. of cormels/plant**	**Wt. of corm/plant(g)**	**Wt. of cormels/plant(g)**	**Moisture (%)**	**Protein (%)**	**Vit. C (mg/100g)**	**Starch content (%)**	**Oxalic acid (%)**	**Yield/ha (q)**
Plant height	**1**	0.31*	0.72***	0.49***	-0.15	-0.56***	0.31*	-0.56***	0.20	-0.37**	-0.08	-0.21	-0.28*	**0.05**
No. of leaves		**1**	0.15	0.81***	0.25	0.28*	0.45***	0.31*	0.05	0.30*	-0.15	0.46***	-0.14	**0.50*** **
LAI			**1**	0.35**	-0.14	-0.37**	0.40**	-0.50***	0.22	-0.44***	0.12	-0.13	-0.37**	**0.12**
No. of suckers/plant				**1**	0.09	0.07	0.28*	0.10	0.13	-0.04	-0.26	0.35**	-0.09	**0.24**
No. of corms/plant					**1**	0.64***	0.12	0.71***	-0.13	0.25	0.19	0.25	-0.03	**0.37*** **
No. of cormels/plant						**1**	0.08	0.87***	-0.21	0.42**	0.12	0.40**	0.18	**0.31*** **
Wt. of corm/plant(g)							**1**	-0.10	0.27*	0.32*	0.27*	0.49***	-0.73***	**0.80*** **
Wt. of cormels/plant(g)								**1**	-0.23	0.47***	-0.03	0.35**	0.24	**0.30*** **
Moisture (%)									**1**	-0.06	0.13	0.36**	-0.27	**0.31*** **
Protein (%)										**1**	0.15	0.50***	-0.12	**0.48*** **
Vit. C (mg/100g)											**1**	0.17	-0.32*	**0.17**
Starch content (%)												**1**	-0.23	**0.65*** **
Oxalic acid (%)													**1**	**-0.64*** **

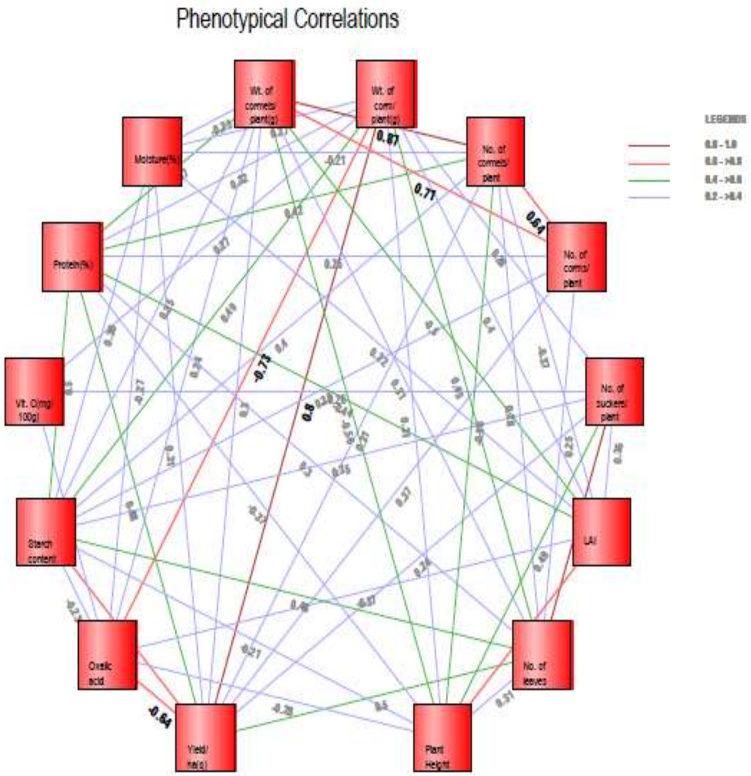


Fig 4.19: Phenotypical correlations

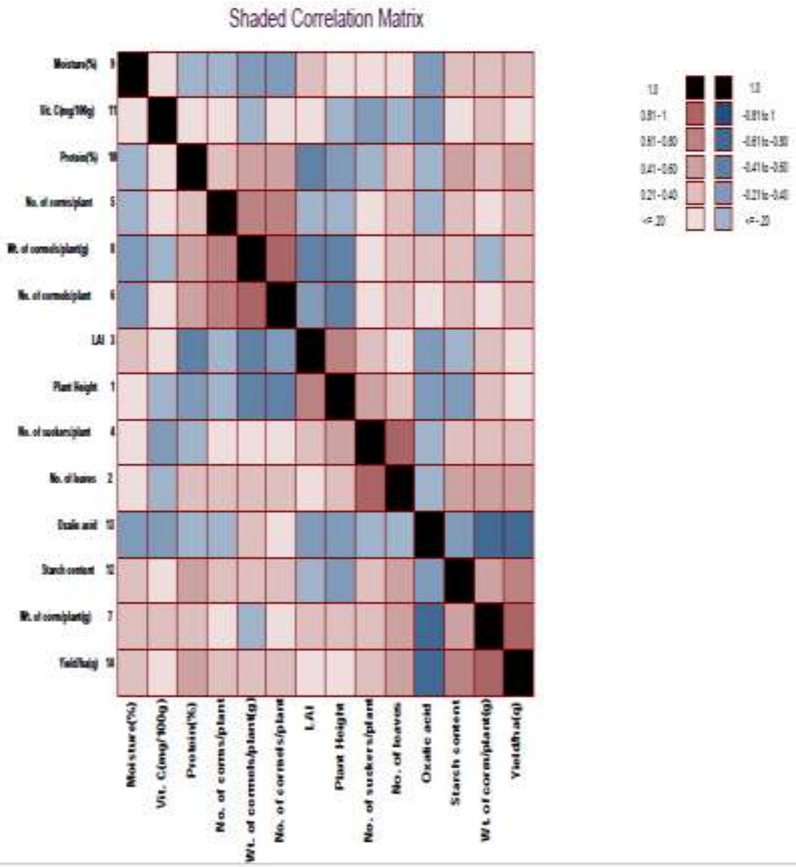


Fig 4.20: Shaded correlation matrix (phenotypic)

4.2.4 Path coefficient analysis

Path coefficient analysis at phenotypic and genotypic level was worked out to study the various characters on yield per plant. The results have been presented in table 4.25 and 4.26.

4.2.5 Path coefficient analysis at genotypic level

At genotypic level, maximum positive direct effect on yield per plant was imposed by weight of corm per plant (2.3718), Weight of cormels per plant (1.5528) and oxalic acid (0.6036). While maximum negative direct effect on yield per plant was recorded for number of cormels per plant (-1.5301) followed by protein (-0.7387) and Leaf Area Index (-0.423).

The maximum positive indirect effect on yield per plant was imposed by number of cormels per plant through weight of cormels per plant (1.3946) followed by starch content through weight of corm per plant (1.372) and number of corms per plant through number of cormels per plant (1.1905). The maximum negative indirect effect on yield per plant was imposed by oxalic acid through weight of corm per plant (-1.9921) followed by weight of cormels per plant through number of cormels per plant (-1.3743) and number of corms per plant through number of cormels per plant (-1.1175).

Table 4.25: Direct and Indirect effect of yield component on yield per ha at Genotypic level in colocasia

Genotypic Path Studies													
Traits	**Plant height**	**No. of leaves**	**LAI**	**No. of suckers/plant**	**No. of corms/plant**	**No. of cormels/plant**	**Wt. of corm/plant(g)**	**Wt. of cormels/plant(g)**	**Moisture(%)**	**Protein(%)**	**Vit. C(mg/100g)**	**Starch content (%)**	**Oxalic acid (%)**
Plant height	-0.18	-0.06	-0.17	-0.09	0.04	0.11	-0.06	0.11	-0.04	0.08	0.02	0.04	0.06
No. of leaves	-0.04	-0.11	-0.02	-0.10	-0.03	-0.03	-0.05	-0.04	-0.01	-0.04	0.02	-0.06	0.02
LAI	-0.39	-0.06	-0.42	-0.17	0.07	0.18	-0.20	0.26	-0.13	0.24	-0.10	0.06	0.20
No. of suckers/plant	-0.20	-0.34	-0.16	-0.40	-0.04	-0.03	-0.12	-0.04	-0.05	0.02	0.14	-0.16	0.01
No. of corms/plant	-0.10	0.13	-0.08	0.05	0.48	0.35	0.05	0.37	-0.06	0.16	0.25	0.16	0.01
No. of cormels/plant	0.92	-0.45	0.66	-0.13	-1.12	-1.53	-0.13	-1.37	0.33	-0.73	-0.29	-0.69	-0.30
Wt. of corm/plant(g)	0.76	1.11	1.14	0.72	0.23	0.20	2.37	-0.28	0.67	0.86	1.01	1.37	-1.99
Wt. of cormels/plant(g)	-0.91	0.52	-0.96	0.16	1.19	1.39	-0.18	1.55	-0.36	0.81	-0.04	0.60	0.39
Moisture (%)	0.04	0.01	0.05	0.02	-0.02	-0.04	0.05	-0.04	0.17	-0.004	0.02	0.07	-0.06
Protein (%)	0.34	-0.25	0.44	0.04	-0.27	-0.38	-0.29	-0.41	0.02	-0.78	-0.13	-0.50	0.17
Vit. C (mg/100g)	0.03	0.07	-0.08	0.12	-0.18	-0.06	-0.14	0.01	-0.04	-0.06	-0.33	-0.12	0.17
Starch content (%)	-0.02	0.05	-0.01	0.04	0.03	0.05	0.06	0.04	0.04	0.07	0.04	0.11	-0.03
Oxalic acid (%)	-0.21	-0.09	-0.29	-0.02	0.01	0.12	-0.50	0.15	-0.20	-0.13	-0.30	-0.16	0.60
Yield/ha(q)	0.04	0.52***	0.11	0.25	0.39***	0.33***	0.85***	0.30***	0.37***	0.51***	0.30***	0.72***	-0.74***
Partial R^2	-0.008	-0.0589	-0.0445	-0.098	0.187	-0.5013	2.0047	0.4732	0.0633	-0.3971	-0.1024	0.0762	-0.4477

R SQUARE = 0.925 RESIDUAL EFFECT = 0.273

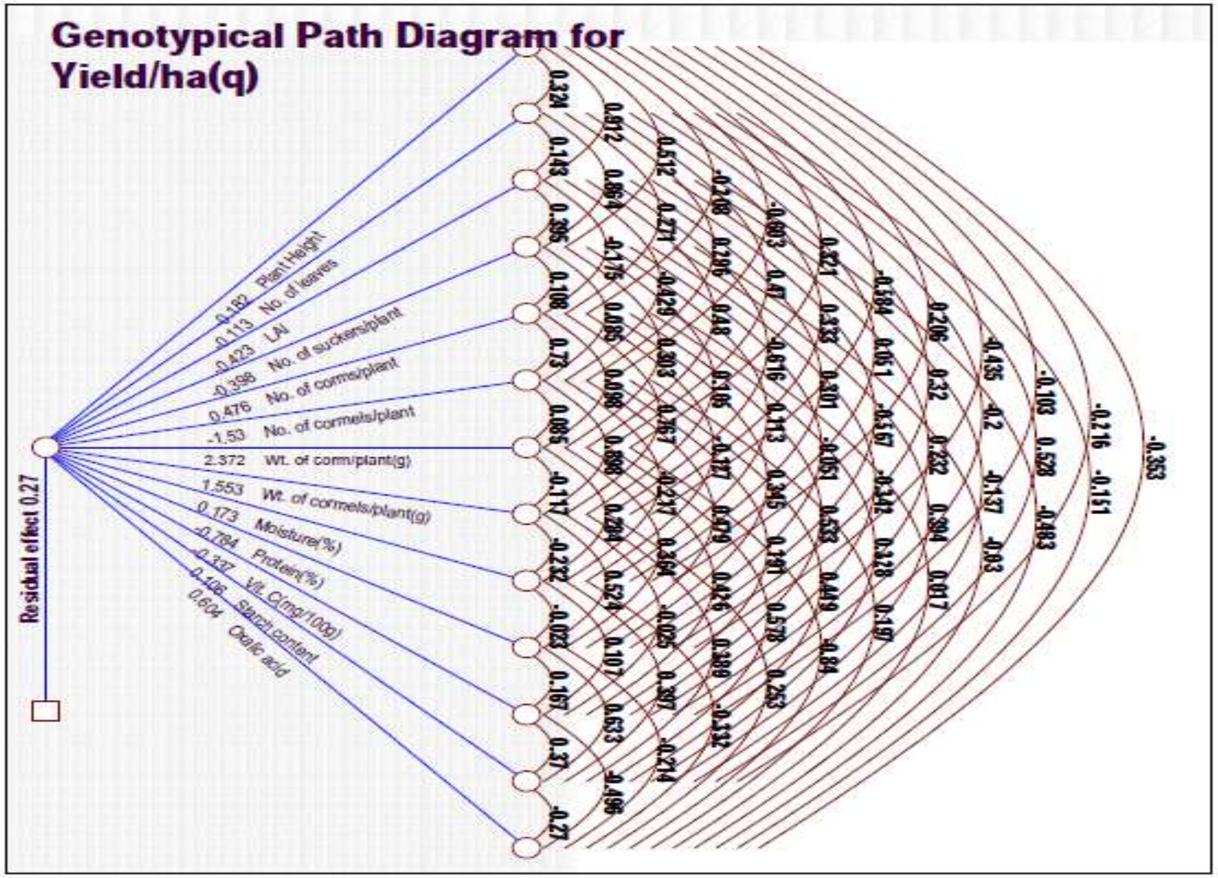


Fig 4.21: Genotypical path diagram for yield/ha(q)

4.2.6 Path coefficient analysis at phenotypic level

A perusal of phenotypic path coefficient analysis showed that maximum direct positive effect on yield per plant was imposed by weight of cormels per plant (0.6354) followed by weight of corm per plant (0.6016) and starch content (0.2205). While maximum negative direct effect on yield per plant were recorded for number of suckers per plant (-0.2892) followed by number of cormels per plant (-0.2539) and oxalic acid (-0.2048).

The maximum positive indirect effect on yield per plant was imposed by number of cormels per plant through weight of cormels per plant (0.5533), followed by number of corms per plant through weight of cormels per plant (0.4518) and protein through weight of cormels per plant (0.2967). Maximum negative indirect effect on yield per plant was imposed by oxalic acid through weight of corm per plant (-0.4396) followed by plant height through weight of cormels per plant (-0.3545) and LAI through weight of cormels per plant (-0.3164). Residual effect at phenotypic level was observed to be 0.3227.

The present study suggests that more emphasis should be given to selecting genotypes having weight of cormels per plant, weight of corm per plant, number of corm per plant and number of cormels per plant. Directly or indirectly all characters showed positive effect on yield which is in confirmation to the finding of Orji and Ogonna (2015), Pranabjyoti (2007) and Vellayudhan *et al.* (2000) in colocasia.

Overall path analysis confirmed that direct effect of weight of cormels per plant, weight of corm per plant, number of corm per plant and number of cormels per plant, moisture content, starch content and protein should be considered simultaneously for amenability in yield of colocasia

Table 4.26: Direct and Indirect effect of yield component on yield per ha at Phenotypic level in colocasia

Phenotypic Path Studies													
Traits	**Plant height**	**No. of leaves**	**LAI**	**No. of suckers/plant**	**No. of corms /plant**	**No. of cormels/plant**	**Wt. of corm/plant(g)**	**Wt. of cormels/plant (g)**	**Moisture (%)**	**Protein(%)**	**Vit. C (mg/100g)**	**Starch content (%)**	**Oxalic acid (%)**
Plant height	0.08	0.02	0.05	0.04	-0.01	-0.04	0.02	-0.04	0.01	-0.03	-0.01	-0.02	-0.02
No. of leaves	0.05	0.17	0.02	0.14	0.04	0.05	0.08	0.05	0.01	0.05	-0.03	0.08	-0.03
LAI	0.03	0.01	0.04	0.02	-0.01	-0.02	0.02	-0.02	0.01	-0.02	0.01	-0.01	-0.02
No. of suckers/plant	-0.14	-0.23	-0.10	-0.29	-0.03	-0.02	-0.08	-0.03	-0.04	0.01	0.07	-0.10	0.0003
No. of corms/plant	0.01	-0.001	0.001	-0.001	-0.01	-0.003	-0.001	-0.004	0.001	-0.001	-0.001	-0.001	0.0002
No. of cormels/plant	0.14	-0.07	0.09	-0.02	-0.16	-0.25	-0.02	-0.22	0.05	-0.11	-0.03	-0.10	-0.05
Wt. of corm/plant(g)	0.18	0.27	0.24	0.17	0.07	0.05	0.60	-0.06	0.16	0.19	0.17	0.29	-0.44
Wt. of cormels/plant (g)	-0.35	0.20	-0.32	0.06	0.45	0.55	-0.07	0.64	-0.14	0.30	-0.02	0.22	0.15
Moisture (%)	0.02	0.01	0.03	0.02	-0.02	-0.02	0.03	-0.03	0.12	-0.01	0.02	0.04	-0.03
Protein (%)	0.01	-0.01	0.02	0.001	-0.01	-0.02	-0.01	-0.02	0.002	-0.03	-0.01	-0.02	0.004
Vit. C (mg/100g)	0.01	0.02	-0.01	0.03	-0.02	-0.01	-0.03	0.003	-0.01	-0.02	-0.10	-0.01	0.03
Starch content (%)	-0.05	0.10	-0.03	0.08	0.06	0.09	0.11	0.08	0.08	0.11	0.04	0.22	-0.05
Oxalic acid (%)	0.06	0.03	0.08	0.0002	0.01	-0.04	0.15	-0.05	0.05	0.03	0.07	0.05	-0.20
Yield/ha(q)	0.05	0.50***	0.12	0.24	0.37***	0.31***	0.80***	0.30***	0.31***	0.48***	0.17	0.65***	-0.64***
Partial R^2	0.0038	0.0878	0.0051	-0.0683	-0.0022	-0.0784	0.4834	0.1879	0.037	-0.0176	-0.0174	0.1425	0.132

R SQUARE = 0.8959 RESIDUAL EFFECT= 0.32

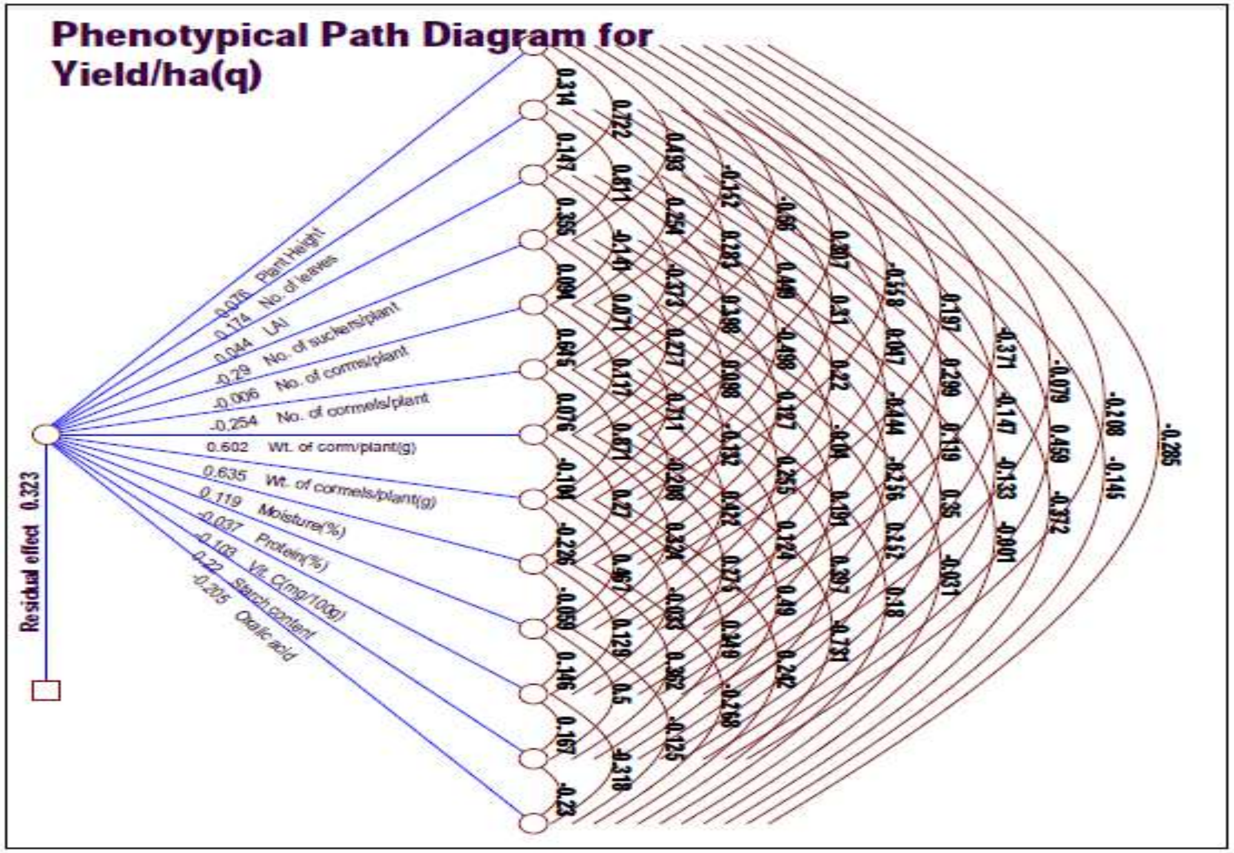


Fig 4.22.: Phenotypical path diagram for yield/ha(q)

4.3 STORAGE LIFE

4.3.1 Physiological loss in weight

With the advancement of storage period (30, 60 & 90 DAS), there was a significant loss in weight irrespective of genotypes as shown in table 4.27 ,4.28 and 4.29 and subsequently in fig 4.23, fig 4.24 and fig 4.25. Among the genotypes G-3(4.29 %, 11.87 % & 16%) followed by G-1 (6.45%, 15.14% & 22.1%) and G-5 (16.73%, 29.15% & 37.75%) recorded minimum physiological loss in weight throughout the storage period. Maximum physiological loss in weight was recorded in G-4 (40.03 %, 70.23% & 78.25%). Similar findings have been reported by Opata and Ogbanna (2015).

4.3.2 Sprouting index

The result obtained from the present investigation showed that there was significant sprouting index during storage as shown in table 4.30, 4.31 and 4.32 and subsequently in fig 4.26, 4.27 and 4.28. Genotypes G-1 and G-3 recorded 0% sprouting index till 60DAS followed by G-18 (0.5%) till 30DAS and G-8, G-9, G15 & G-16 (1%) till 30 DAS. G-4 (6.55%, 13.1% and 22.25%) recorded maximum sprouting index. Similar findings have been reported by Opata and Ogbanna (2015).

4.3.3 Rotting index

A significant variation in rotting index during storage was observed as shown in table 4.33, 4.34 and 4.35 and in fig 4.29, 4.30 and 4.31. The genotypes G-1, G-3 and G-16 were recorded to have 0% rotting index till 60 DAS followed by genotypes G-2, G-6, G-7 and G-13 were recorded to have 0% rotting till 30 DAS and G-15 (0.15%) till 30 DAS. G-4 (19.5%, 36.35% & 69.75%) recorded maximum rotting index throughout the storage.

Similar findings in physiological loss in weight, sprouting index and rotting index were attributed to genotype variability in response to transpiration and respiration in storage condition, similarly reported by Ovono *et al.* (2010), Pranabjyoti (2007), Sajeev *et al.* (2006) and Bhaskar *et al.* (2003) in colocasia

Table 4.27: Physiological loss in weight (PLW) of colocasia at 30DAS

Genotypes	30 DAS		
	1st year (2017)	2nd year (2018)	POOLED
Genotype-1	6.39	6.51	6.45
Genotype-2	24.24	23.16	23.7
Genotype-3	4.46	4.12	4.29
Genotype-4	40.21	39.84	40.03
Genotype-5	16.24	17.21	16.73
Genotype-6	26.67	26.54	26.61
Genotype-7	25.02	28.9	26.96
Genotype-8	33.93	33.56	33.75
Genotype-9	18.34	16.2	17.27
Genotype-10	27.27	26.12	26.70
Genotype-11	26	28.47	27.24
Genotype-12	24.44	25.5	24.97
Genotype-13	23.53	23.6	23.57
Genotype-14	23.81	24.7	24.26
Genotype-15	28	24.56	26.28
Genotype-16	26.25	27.45	26.85
Genotype-17	28.95	27.44	28.20
Genotype-18	27.62	28.69	28.16
Mean	24	24	24
Range Lowest	4.28	4.29	4.29
Range Highest	40.02	40.03	40.03
C.V.	56.32	56.33	56.33
C.D. 5%	5.20	5.21	5.21

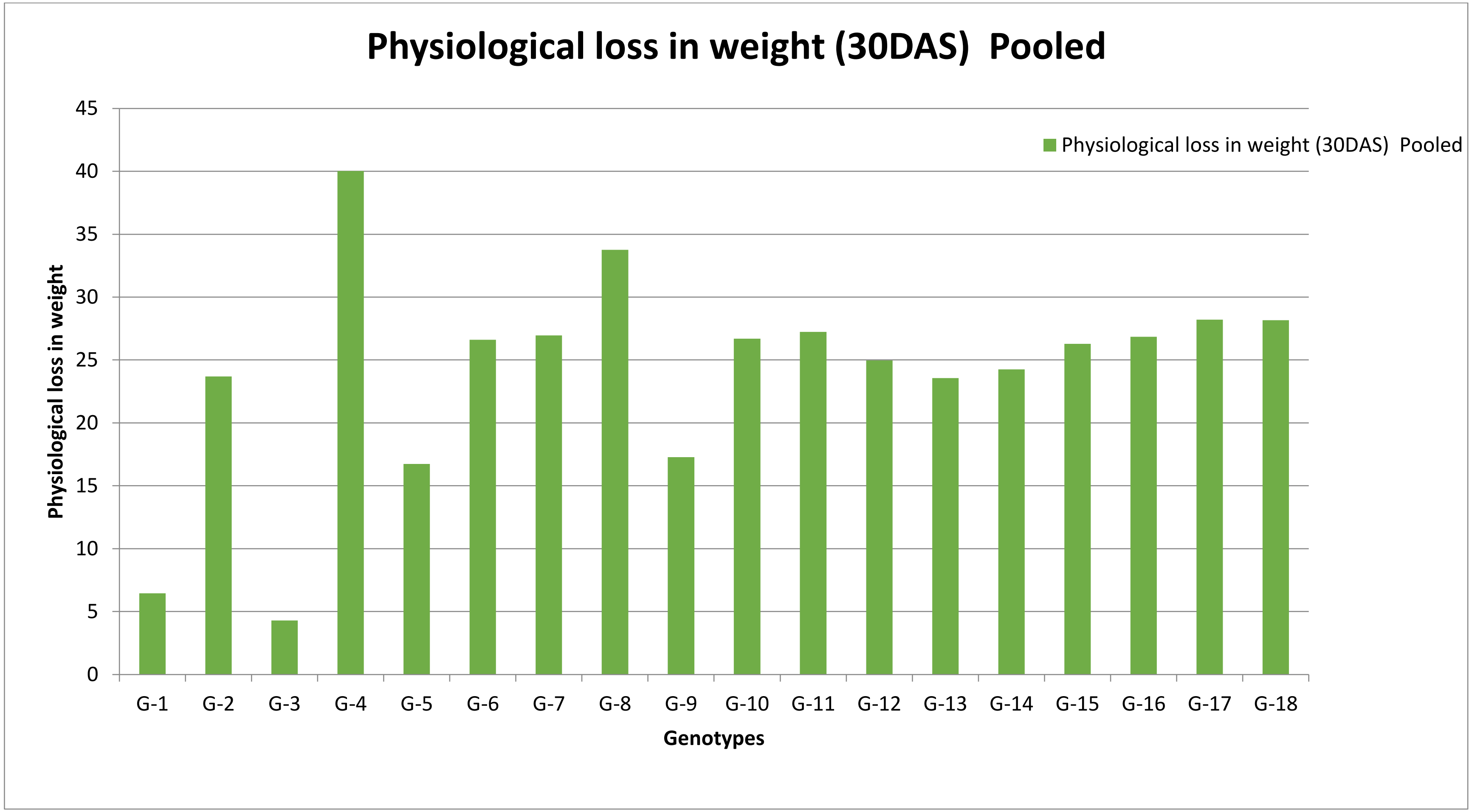


Fig4. 23: Physiological Loss in Weight at 30 DAS

Table 4.28: Physiological loss in weight (PLW) of colocasia at 60 DAS

Genotypes	60 DAS		
	1st year (2017)	2nd year (2018)	POOLED
Genotype-1	14.89	15.14	15.02
Genotype-2	42.3	41.8	42.05
Genotype-3	12.1	11.63	11.87
Genotype-4	71.4	70.23	70.82
Genotype-5	29.4	26.4	27.9
Genotype-6	39.8	40.2	40
Genotype-7	38.6	42.6	40.6
Genotype-8	51.23	51	51.12
Genotype-9	28.6	29.7	29.15
Genotype-10	47.4	46.9	47.15
Genotype-11	45.5	46.6	46.05
Genotype-12	43.2	44	43.6
Genotype-13	35.1	35.3	35.2
Genotype-14	34.3	34.6	34.45
Genotype-15	43.3	45.2	44.25
Genotype-16	42.6	43.2	42.9
Genotype-17	51.2	48	49.6
Genotype-18	48.6	47.6	48.1
Mean	39.98	39.99	39.99
Range Lowest	11.86	11.87	11.87
Range Highest	70.8	70.82	70.82
C.V.	45.7	45.8	45.8
C.D. 5%	8.74	8.75	8.75

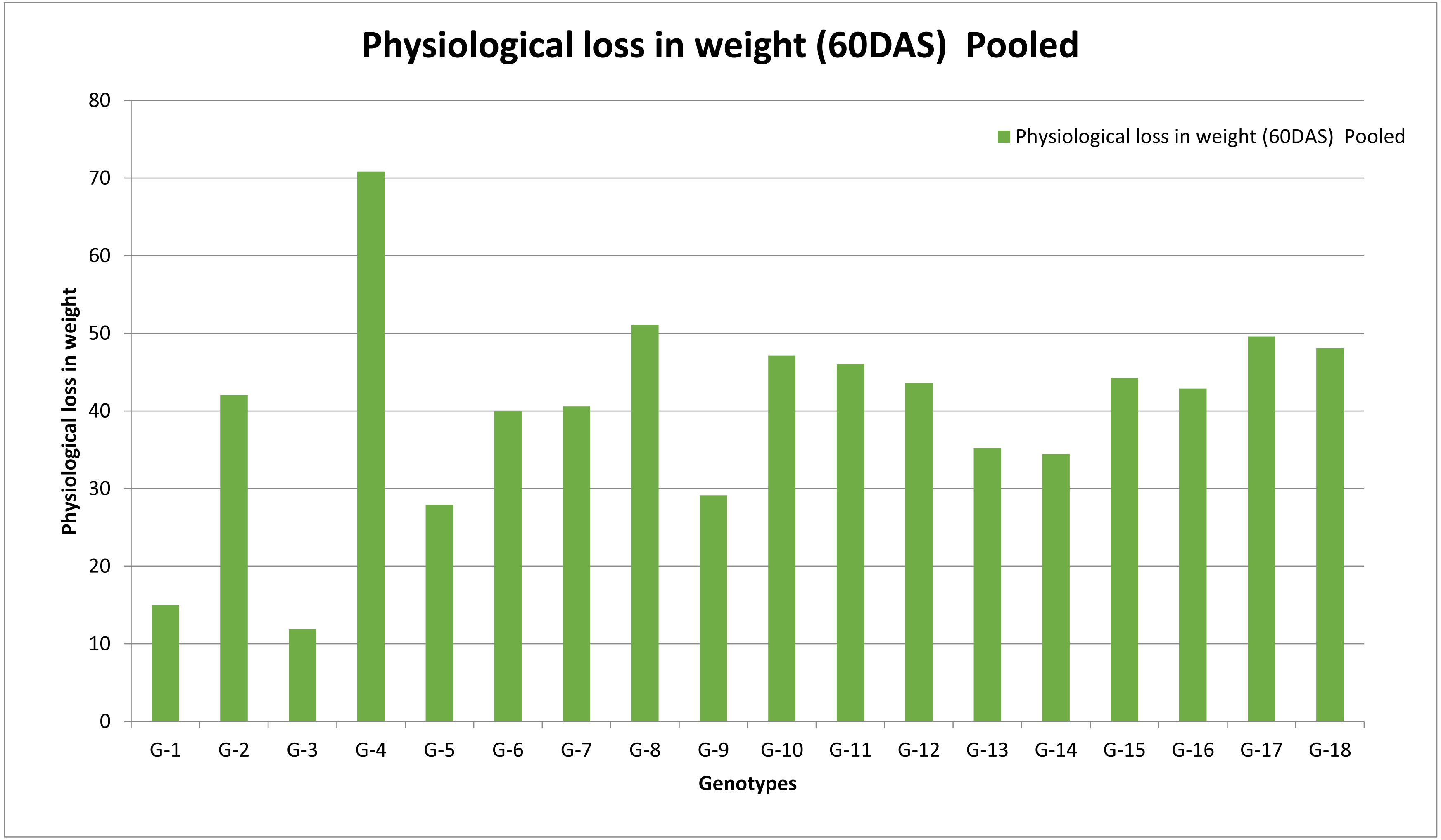


Fig 4.24: Physiological Loss in Weight at 60 DAS

Table 4.29: Physiological loss in weight (PLW) of colocasia at 90 DAS

Genotypes	90 DAS		
	1st year (2017)	2nd year (2018)	POOLED
Genotype-1	21.6	22.6	22.1
Genotype-2	51.3	50.2	50.75
Genotype-3	16.3	15.7	16
Genotype-4	78.9	77.6	78.25
Genotype-5	35.6	32.6	34.1
Genotype-6	46.5	47.8	47.15
Genotype-7	44.3	46.5	45.4
Genotype-8	58.6	57	57.8
Genotype-9	36.8	38.7	37.75
Genotype-10	51.2	50.8	51
Genotype-11	51.7	52.6	52.15
Genotype-12	48.6	49	48.8
Genotype-13	43.4	43.56	43.48
Genotype-14	41.5	41.7	41.6
Genotype-15	54.7	53.12	53.91
Genotype-16	48.9	49.7	49.3
Genotype-17	58.6	56.8	57.7
Genotype-18	47.9	48.15	48.03
Mean	46.3	46.4	46.40
Range Lowest	15.8	16	16
Range Highest	78.24	78.25	78.25
C.V.	68.2	68.3	68.3
C.D. 5%	9.4	9.41	9.41

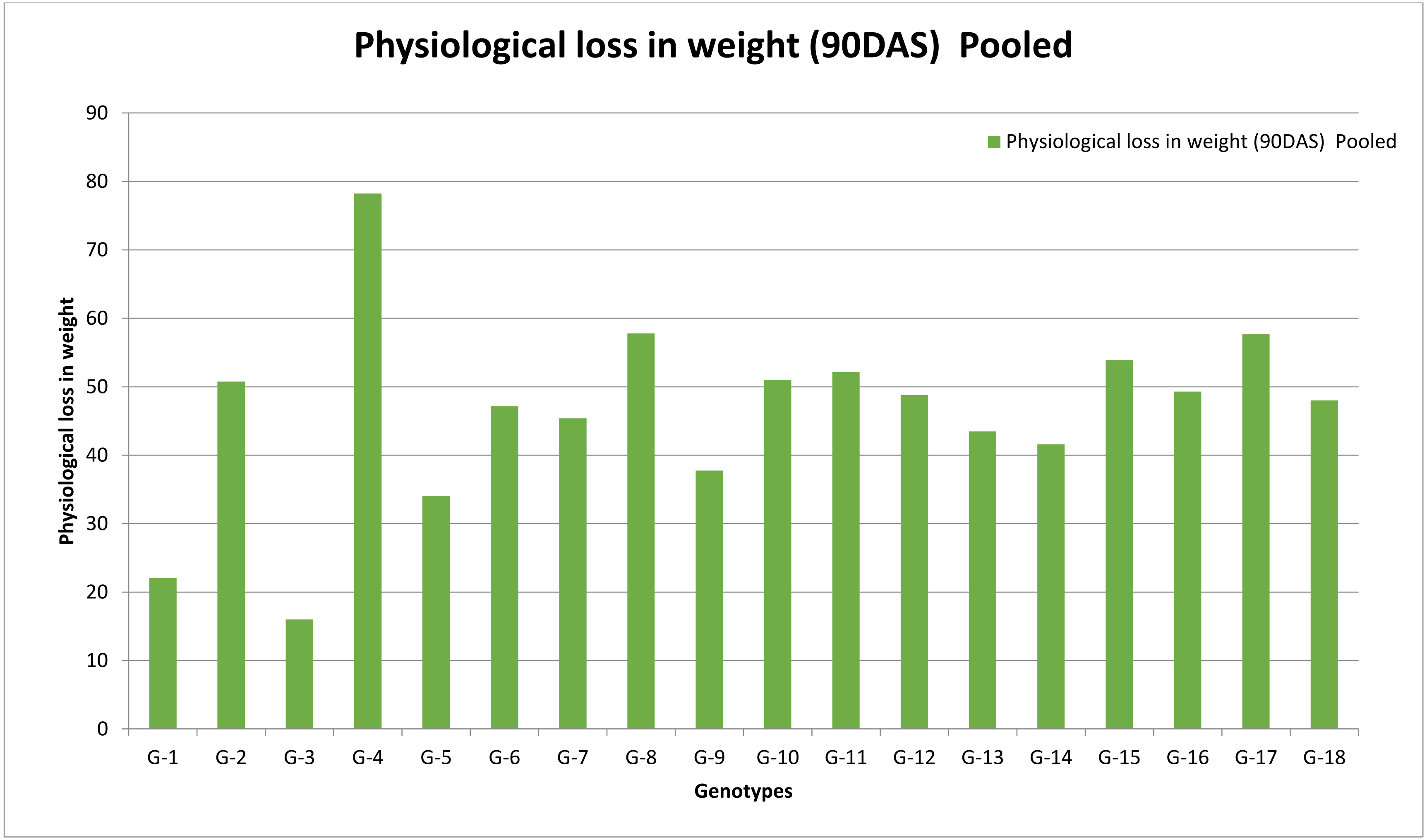


Fig 4.25: Physiological Loss in Weight at 90 DAS

Table 4.30: Sprouting Index of colocasia at 30 DAS

Genotypes	30 DAS		
	1st year (2017)	**2nd year (2018)**	**POOLED**
Genotype-1	0	0	0
Genotype-2	1.2	1	1.1
Genotype-3	0	0	0
Genotype-4	0	0	0
Genotype-5	1	1	1
Genotype-6	2	2.3	2.15
Genotype-7	2.1	2.4	1.25
Genotype-8	1	1	1
Genotype-9	6.2	5.6	5.9
Genotype-10	3.4	3.5	3.45
Genotype-11	2.4	2.7	2.5
Genotype-12	1	2.2	1.6
Genotype-13	5.4	4.8	5.1
Genotype-14	2	2.1	2.05
Genotype-15	1	1	1
Genotype-16	6.8	6.3	6.55
Genotype-17	1	1.2	1.1
Genotype-18	1	0	0.5
Mean	2.05	2.06	2.06
Range Lowest	0	0	0
Range Highest	6.54	6.55	6.55
C.V.	16.1	16.2	16.2
C.D. 5%	0.12	0.13	0.13

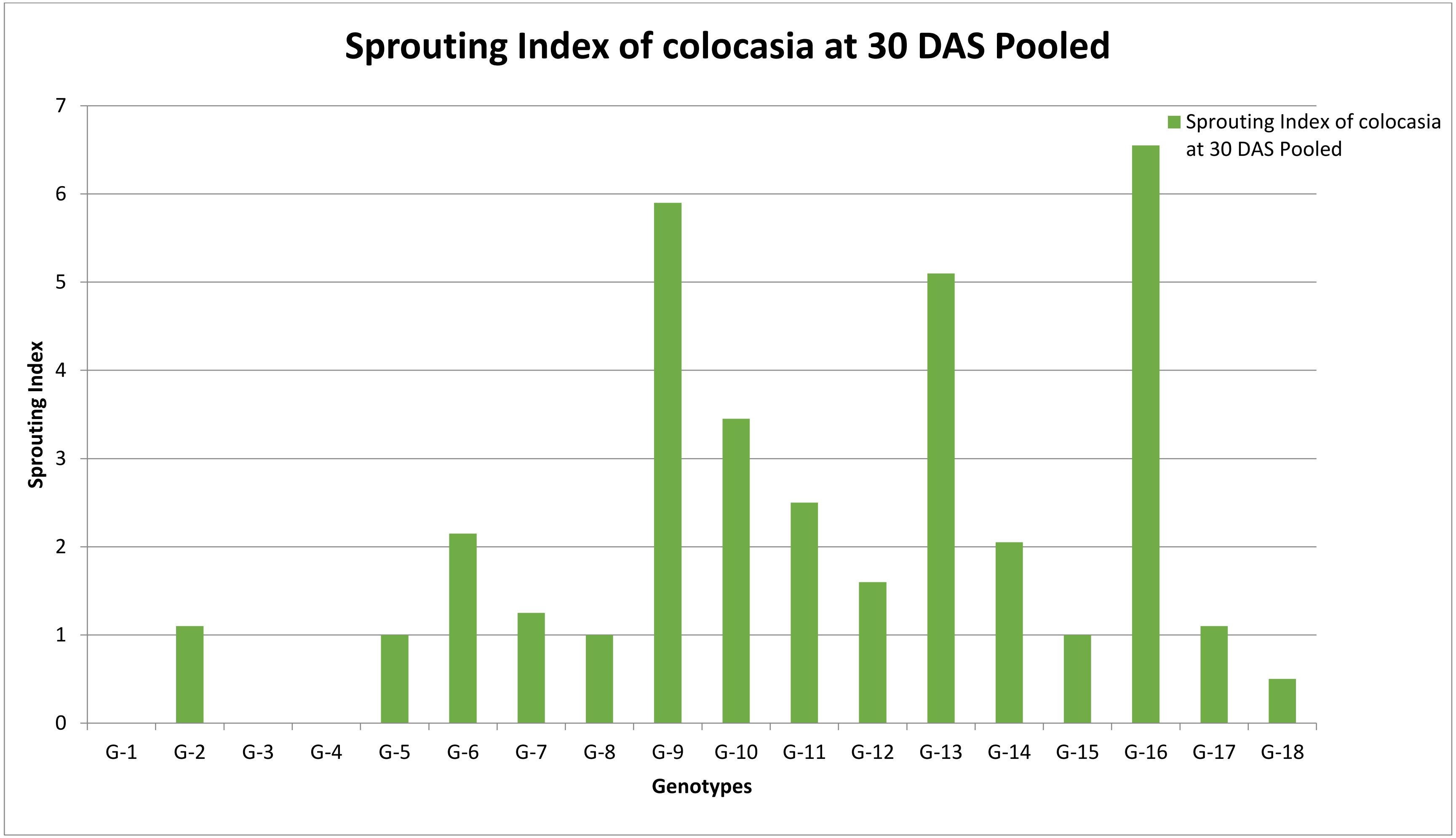


Fig 4.26: Sprouting Index at 30 DAS.

Table 4.31: Sprouting Index of colocasia at 60 DAS

Genotypes	60 DAS		
	1st year (2017)	2nd year (2018)	POOLED
Genotype-1	0	0	0
Genotype-2	2.4	2.1	2.25
Genotype-3	2.6	3.4	3
Genotype-4	0	0	0
Genotype-5	2.2	2.1	2.15
Genotype-6	5.2	5.6	5.4
Genotype-7	5.1	5.2	5.15
Genotype-8	2.3	2	2.15
Genotype-9	12.8	11.4	12.1
Genotype-10	8.6	9.2	8.9
Genotype-11	6.2	7.4	6.8
Genotype-12	2.4	3.6	3
Genotype-13	11.1	10.8	10.95
Genotype-14	2.4	3.8	3.1
Genotype-15	3	4.6	3.8
Genotype-16	12.8	13.4	13.1
Genotype-17	2.6	3.2	2.9
Genotype-18	2.4	1	1.7
Mean	4.7	4.81	4.80
Range Lowest	0	0	0
Range Highest	13.1	13.1	13.1
C.V.	18.3	18.4	18.4
C.D. 5%	0.47	0.48	0.48

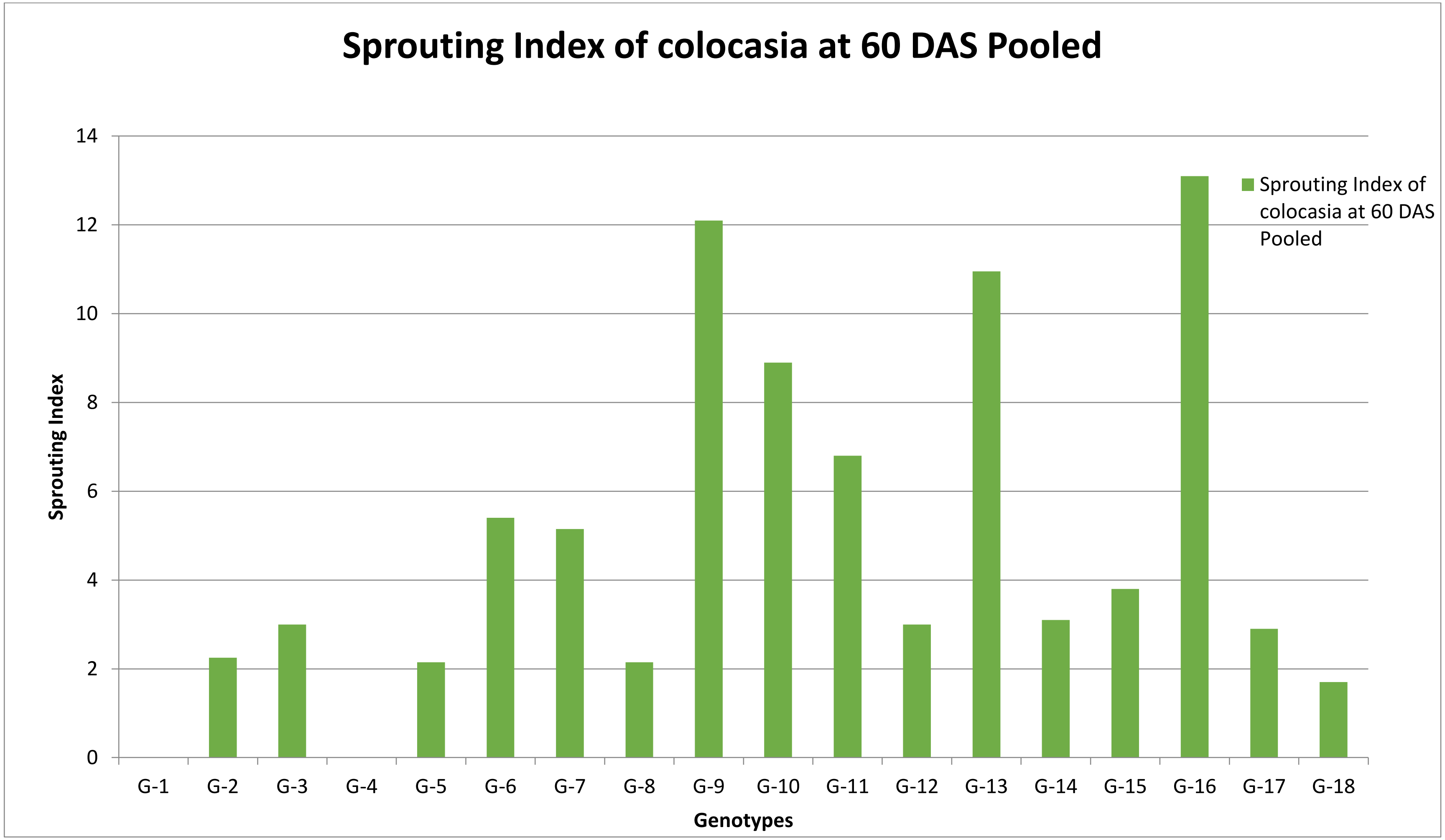


Fig 4.27: Sprouting Index at 60DAS

Table 4.32: Sprouting Index of colocasia at 90 DAS

Genotypes	90 DAS		
	1st year (2017)	2nd year (2018)	POOLED
Genotype-1	2.3	2.1	2.2
Genotype-2	5.1	4.6	4.85
Genotype-3	2.8	2.1	2.45
Genotype-4	4.6	6.2	5.4
Genotype-5	3.6	3.1	3.35
Genotype-6	10.4	11.4	10.9
Genotype-7	9.8	9.8	9.8
Genotype-8	4.8	4.2	4.5
Genotype-9	20.5	20.2	20.35
Genotype-10	15.4	16.4	15.9
Genotype-11	12.3	14.3	8.3
Genotype-12	4.4	6.4	5.4
Genotype-13	18.4	17.6	15.5
Genotype-14	4.3	6.2	5.25
Genotype-15	6.4	8.7	7.55
Genotype-16	21.3	23.2	22.25
Genotype-17	5.4	7.1	6.25
Genotype-18	4.8	2.6	3.7
Mean	8.4	8.5	8.55
Range Lowest	2.1	2.2	2.2
Range Highest	22.21	22.27	22.25
C.V.	19.5	19.6	19.6
C.D. 5%	1.4	1.5	1.5

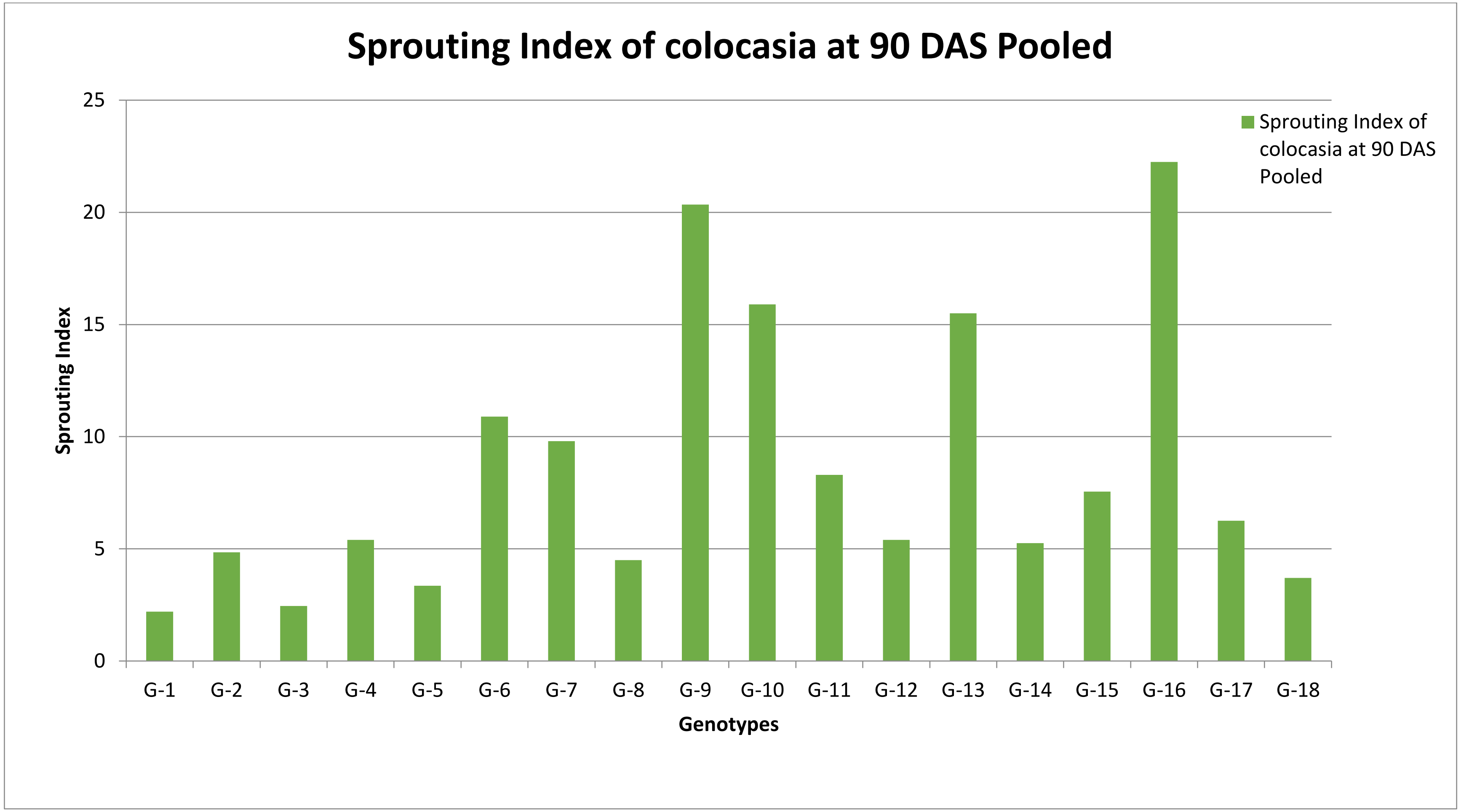


Fig 4.28: Sprouting index at 90 DAS.

Table 4.33: Rotting Index of colocasia at 30DAS

Genotypes	30 DAS		
	1st year (2017)	2nd year (2018)	POOLED
Genotype-1	0	0	0
Genotype-2	0	0	0
Genotype-3	0	0	0
Genotype-4	18.75	19.56	19.15
Genotype-5	4.2	3.5	3.85
Genotype-6	0	0	0
Genotype-7	0	0	0
Genotype-8	6.1	6.8	6.45
Genotype-9	2.63	2.21	2.42
Genotype-10	4.6	4.8	4.7
Genotype-11	5.2	5.6	5.4
Genotype-12	4.3	4.2	4.25
Genotype-13	0	0	0
Genotype-14	0	1	0.5
Genotype-15	0	0	0
Genotype-16	0	0	0
Genotype-17	4.9	5.1	5
Genotype-18	0	0	0
Mean	6.64	6.9	6.87
Range Lowest	0	0	0
Range Highest	18.75	19.65	19.5
C.V.	23.1	23.4	23.4
C.D. 5%	1.2	1.3	1.3

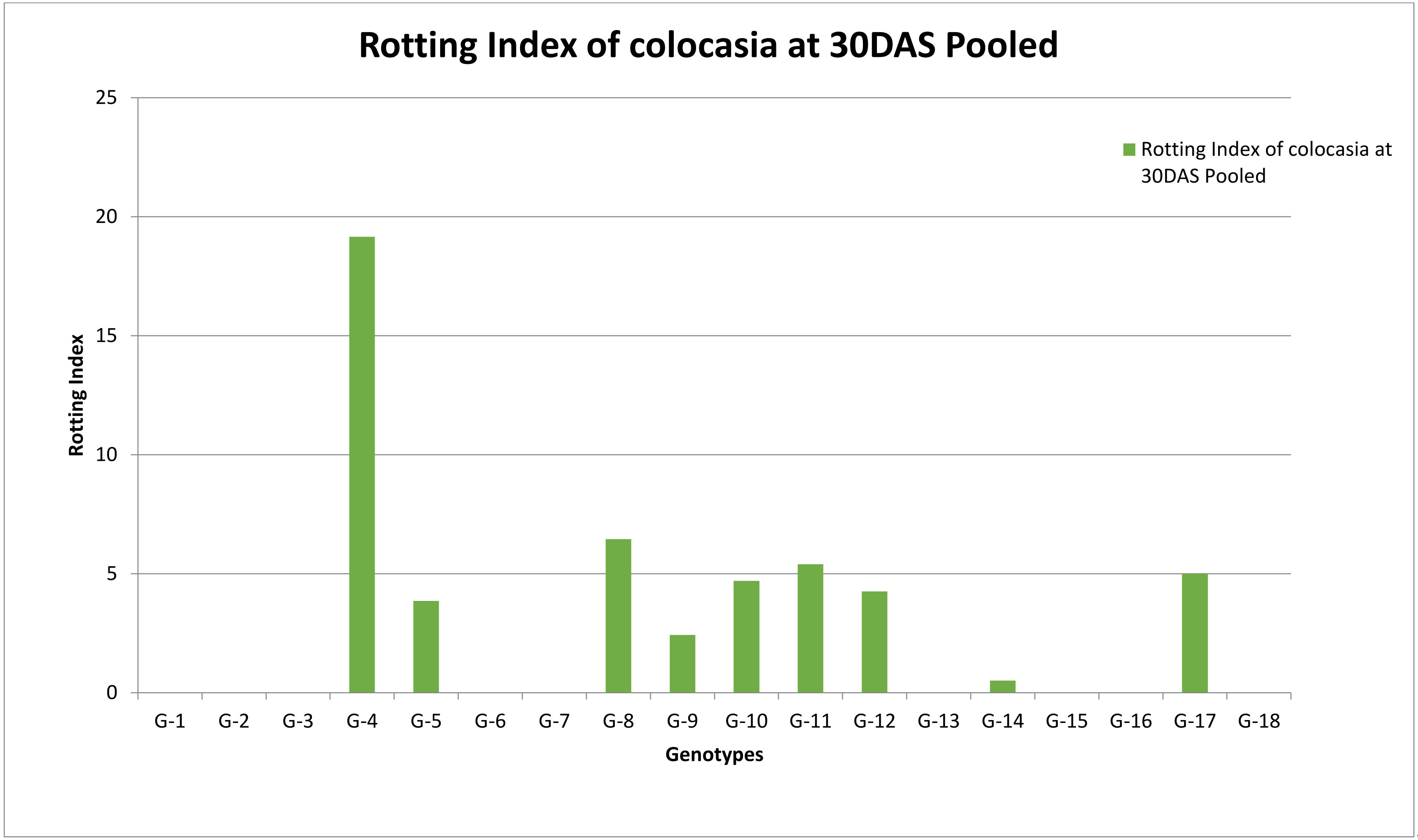


Fig 4.29: Rotting Index at 30 DAS.

Table 4.34: Rotting Index of colocasia at 60 DAS

Genotypes	60 DAS		
	1st year (2017)	2nd year (2018)	POOLED
Genotype-1	0	0	0
Genotype-2	3.1	1	2.05
Genotype-3	0	0	0
Genotype-4	35.4	37.3	36.35
Genotype-5	9.5	7.6	8.55
Genotype-6	2.1	1.6	1.85
Genotype-7	3.4	3.2	3.3
Genotype-8	12.8	12.4	12.6
Genotype-9	4.5	4	4.25
Genotype-10	7.6	7	7.3
Genotype-11	12.6	12.8	12.7
Genotype-12	9.7	6.3	8
Genotype-13	0	1	0.5
Genotype-14	1.2	1	1.1
Genotype-15	3.1	3.2	3.15
Genotype-16	0	0	0
Genotype-17	10.6	10.4	10.5
Genotype-18	2.8	2.4	2.6
Mean	6.56	6.78	6.75
Range Lowest	0	0	0
Range Highest	35.4	37.3	36.35
C.V.	28.3	28.4	28.4
C.D. 5%	1.4	1.45	1.45

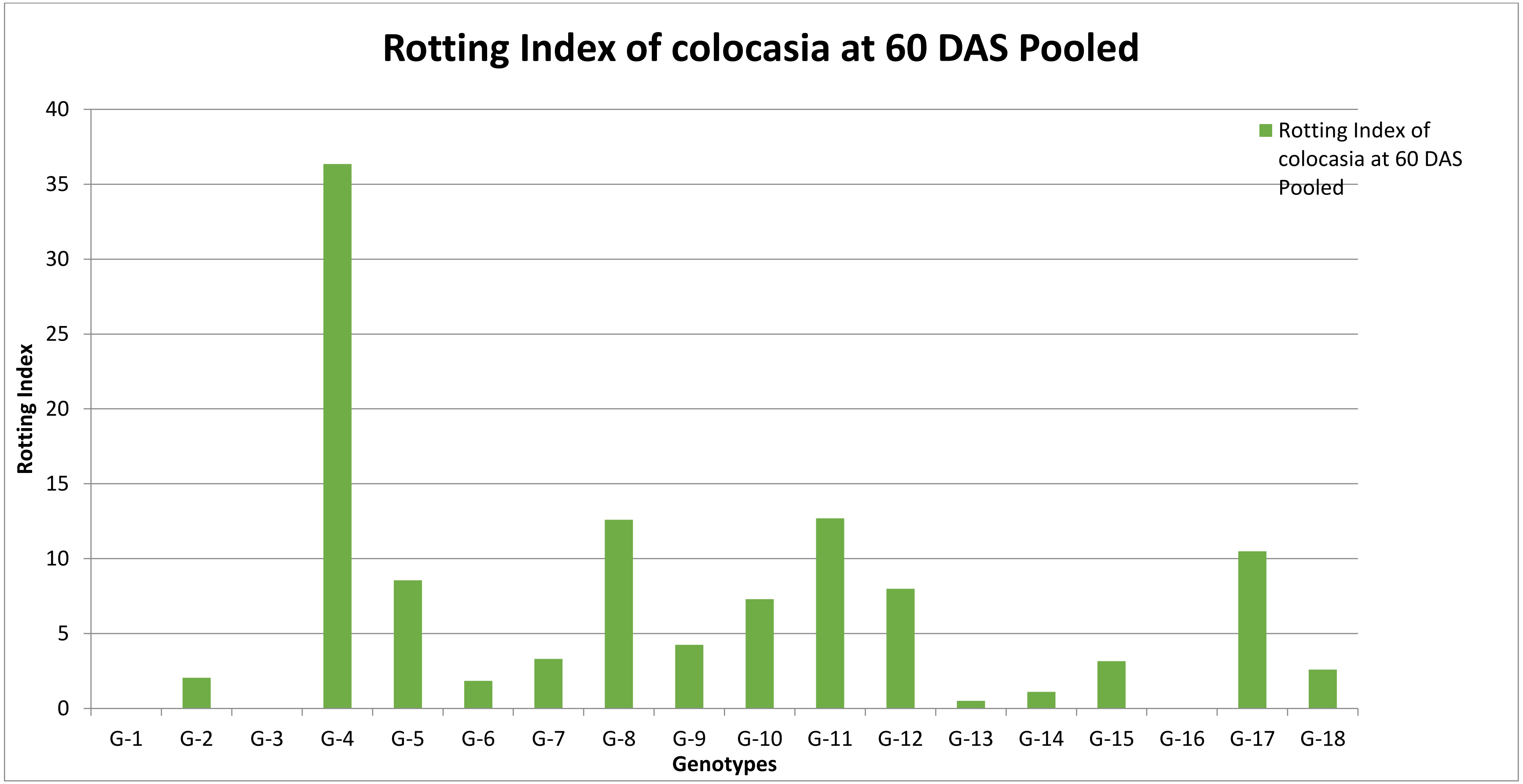


Fig 4.30: Rotting Index at 60 DAS.

Table 4.35: Rotting Index of colocasia at 90 DAS

Genotypes	90 DAS		
	1st year (2017)	2nd year (2018)	POOLED
Genotype-1	1.6	1.8	1.7
Genotype-2	7.4	2.4	4.9
Genotype-3	1.5	1.6	1.6
Genotype-4	68.3	71.2	69.75
Genotype-5	17.5	12.3	14.9
Genotype-6	3.6	3.2	3.4
Genotype-7	7.8	7	7.4
Genotype-8	20.14	20.4	20.27
Genotype-9	8.4	7.8	8.1
Genotype-10	12.3	12	12.15
Genotype-11	20.4	20.1	20.25
Genotype-12	15.6	10.4	13
Genotype-13	1.2	2.3	1.75
Genotype-14	2.3	2.1	2.2
Genotype-15	7.4	7.5	7.45
Genotype-16	1	2.3	1.85
Genotype-17	18.6	18.4	18.5
Genotype-18	4.3	4.2	4.25
Mean	11.8	11.9	11.86
Range Lowest	1	1.6	1.6
Range Highest	68.3	71.2	69.75
C.V.	29.88	29.89	29.89
C.D. 5%	1.7	1.7	1.7

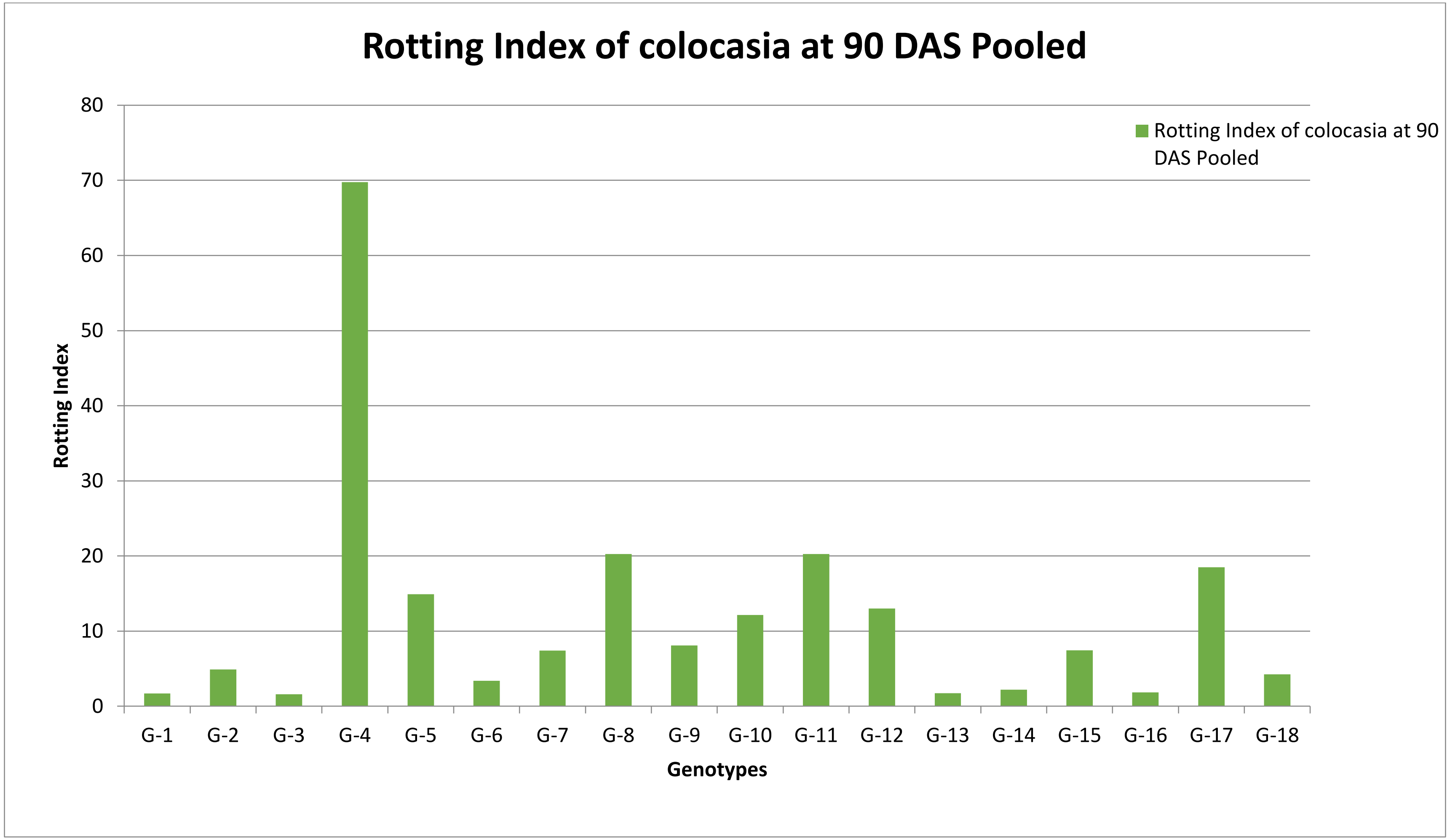


Fig 4.31: Rotting Index at 90 DAS.

PLATE 8: Storage of colocasia

Sprouting at 30 days during storage **Sprouting at 60 days during storage**

Sprouting at 90 days during storage

PLATE 9: Sprouting at storage at 30,60 and 90 DAS

Rotting at 30 days during storage

Rotting at 60 days during storage

Rotting at 90 days during storage

PLATE 10: Rotting at storage

CHAPTER V
SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

The present investigation entitled **“Characterization of Colocasia (*Colocasia esculenta* L. Schott) genotypes available in Mon district of Nagaland”** has been carried out at horticulture farm at School of Agricultural Sciences, Medziphema, Nagaland University during *Kharif* season in the year 2017 & 2018. The experiment was conducted in Randomized Block Design (RBD) with eighteen treatments in three replications of colocasia genotypes collected from different regions of Mon district of Nagaland to estimate growth, yield and quality parameters along with genetic variability, correlation coefficient, path analysis and storage life.

Five randomly selected plants were considered for observation of different character *viz.* plant height, number of functional leaves, Leaf Area Index (LAI), number of suckers per plant, number of corm per plant, number of cormels per plant, weight of corm, weight of cormel, moisture, protein, vitamin C, starch, oxalic acid, yield per plot and yield per hectare .

The analysis of variance indicated that the mean sum of square due to genotypes were highly significant for all the characters. Significant means sum of square due to yield and attributing characters revealed existence of considerable variability in material studied for improvement of various traits.

The details of the material and method used and followed during the experiment for recording various observations and analysis is presented below.

Morphological parameters

With respect to corm shape elliptical was found in genotype (G-11 and G-14), conical (G-6 and G-7), cylindrical (G-17), round (G-1, G-2, G-3, G-5, G-9, G-10, G-13 and G-16). G-12 was found to be clustered, flat and multifaced.

G-16 was also found to be clustered type. Genotypes (G-4, G-8, G-15 and G-18) were found to be elongated.

With respect to cormel shape the following eleven genotypes exhibited round cormel shape (G-1, G-2, G-3, G-4, G-5,G-8, G-9,G-10,G-13 G-14 and G-16), four genotypes (G-12, G-15, G-17 & G-18) were found to be elongated, conical shape was found in G-7, and elliptical cormel was found in G-6 and G-11.

With respect topetiole base colour green was observed in (G-7, G-10), yellow colour was observed in (G-2, G8), creamish colour was observed in (G-1. G-4, G-9, G-14, G-16), pinkish colour was observed in (G-5) , purple colour was observed in (G-6) and reddish colour was observed in (G-15).

With respect to petiole colour purple was observed in (G-6, G-15, G-17) and reddish colour was observed in (G-18) while the rest were found to have green petiole.

With respect to leaf base shape, all eighteen genotypes exhibited peltate type leaf base shape.

With respect to predominant position (shape) of leaf lamina surface, erect –apex down position was observed.

With respect to leaf blade margin, two kinds were observed, *viz*undulate and sinuate leaf blade margin., whereby genotypes (G-1, G-2, G-3, G-4, G-5, G-7, G-8, G-9, G-10, G-13. G-14, G-16 and G-18) exhibited undulate leaf blade margin. And genotypes (G-6, G-11, G-12, G-15 and G-17) exhibited sinuate leaf blade margin.

With respect to leaf blade colour, the genotypes (G-1, G-2, G-3, G-4, G-5, G-6, G-7, G-8, G-10, G-11 and G-17) exhibited dark green colour. While genotypes (G-9, G-12, G-13, G-14, G-15, G-16 and G-18) exhibited green leaf blade colour.

With respect to leaf main vein colour, genotypes (G-1, G-7, G-8, G-10, G-14, g-15, G-17 and G-18) exhibited green leaf main vein colour, Whitish leaf main vein colour was exhibited by genotypes (G-3, G-4, G-5, G-11, G-12, G-13 and G-16). Yellow leaf main vein colour was exhibited by genotype G-2 and G-9. Genotype G-6 exhibited purple leaf main vein colour.

With respect to vein pattern, all other genotypes exhibited Y pattern vein pattern, while genotype G-15 exhibited Y pattern and extending to secondary veins.

Growth parameters

With respect to growth parameters such as plant height were found to be highest at G-8(98.43 cm). The highest number of functional leaves was recorded in G-4(21.12). The largest Leaf Area Index(LAI) was found in G-8(0.28). The highest number of suckers per plant was recorded in G-7 (6.11).

Biochemical parameters

Biochemical parameters with respect to moisture content were observed in G-4(84.46%), highest protein content was observed in G-4(2.44%), highest Vitamin C content was recorded in G-3(134.05 mg/100g), highest starch content was recorded in G-1(16.87%) and minimum oxalic acid content was recorded in G-1(0.30%).

Yield parameters

In yield parameters, the highest number of corms per plant was found in G-5 (2.42). The highest number of cormels per plant was recorded at G-16 (11.26). The highest weight of corms per plant (g) was observed in G-1 (430.94g). The highest weight of cormels per plant (g) was recorded at G-16 (363.89g). The highest yield per plot (kg) was recorded at G-1 (12.94kg). The highest yield per ha (q) was recorded in G-1 (241.50 q).

Genetic parameters

Characters like plant height, number of leaves, number of suckers per plant, number of cormels per plant, weight of corm per plant, weight of cormels per plant, yield per plot and yield per ha recorded highest heritability coupled with high genetic advance which indicated that the observed characters are under additive gene effect and hence these characters are more reliable for effective selection.

High magnitude of phenotypic as well as genotypic coefficient of variations were recorded for traits *viz*, weight of corm per plant (46.48 % and 45.91%), number of cormels per plant (31.40% and 30.47%), weight of cormel per plant (31.29% and 30.68%), number of suckers per plant (29.13% and 27.88%), number of leaves (28.32% and 27.32%), number of corm (26.72% and 24.22%), leaf area index (24.66% and 20.24%), oxalic acid (23.97% and 21.23%), yield per plot (22.11% and 21.44%), plant height (22.06% and 21.26%) and yield per hectare(21.90% and 21.28%). This high value of PCV and GCV indicated that maximum variability existed in these traits and there was enough scope for further improvement.

Correlation studies revealed that Leaf Area Index (LAI), number of suckers per plant, weight of cormels per plant, starch content have the highest significant positive correlation with yield both at genotypic and phenotypic level. Hence direct selection based on these traits would result in improvement in yield.

Path coefficient analysis revealed that maximum positive direct effect on yield was imposed by weight of corm/plant followed by weight of cormels per plant and indirect maximum positive effect was found in number of cormels per plant through weight of cormels per plant. This indicates that these independent characters have maximum contribution towards yield per ha. Hence it would be rewarding to lay focus on these characters in selection programmes.

CONCLUSIONS

The analysis of variance showed that considerable variability existed among the genotypes for most of the traits showing possibilities of further genetic improvement in colocasia.

- Assemblage of eighteen different genotypes from farmers of different regions under Mon district of Nagaland was done. In the jhum system of cultivation where Konyak farmers slash and burn the jungles before the cultivation is done, colocasia is mostly grown as a mixed crop along with paddy and other vegetables. The colocasia genotypes were mostly collected from the jhum field's harvest.
- The mean performance for yield per hectare of G-1 Nalon was superior amongst all genotypes. High heritability coupled with high genetic advance was observed for traits like width of leaf, number of fruits per plant, fruit weight, fruit length, yield per plant and yield per hectare. The PCV was greater than GCV and hence the role of environment affects extent of variability in a trait within a population.
- Correlation studies revealed that characters namely number of leaves, number of corm, number of cormels, weight of corm, weight of cormels, moisture content, protein content, starch content had significant positive correlation with yield per ha.
- High yield may be attributed to higher utilization of photosynthesis due to maximum growth variables like higher number of leaves.
- High yield potential as well as excellent storage life exhibited by G-1(Nalon)which itself has been collected from the foothill regions of Mon district confirmed that it is the best colocasia genotype under existing agro-climatic condition i.e. foothill of SAS research farm Medziphema. Based on the mean performance of eighteen colocasia genotype it can be concluded that genotype G-1(Nalon) was the best performing genotype.

- The storage life was observed upto 90 days after harvest. The physiological loss in weight, sprouting index and rotting index was observed during 30, 60 and 90 days interval.
- Among the genotypes, G-3 recorded lowest physiological loss in weight, followed by G-1 and G-5. Maximum physiological loss in weight was recorded in G-4(40.03% at 30 DAS, 70.2 % at 60 DAS, 78.25% at 90 DAS).
- Sprouting index investigation showed significant sprouting where G-16 recorded maximum sprouting.(6.55% at 30 DAS, 13.1 % at 60 DAS and 21.25 % at 90 DAS)
- Rotting index was recorded maximum in G-4 (19.5 % at 30 DAS, 36.35 % at 60 DAS and 69.75 % at 90 DAS)

FUTURE LINE OF WORK

- Selected parents with desirable yield per plant with respect to different component traits can be involved in multiple crossing schemes to recombine different productivity components.

- Advanced molecular techniques could be employed to identify duplicate genotypes for efficient management of colocasia genotypes and to tag important gene available in the germplasm through linkage to DNA markers.

- Promising high yielding genotypes were identified. Therefore, these can be tested over different locations and trails for their yield stability.

- There is need to consider effort in conservation and research for the selection of genotypes, especially the north eastern region of India, which has huge gene pool reserve of colocasia but untapped potential.

- Most of the landraces are usually low yielders. Hence genetic improvement by selection is the best way to improve yield and quality in taro.

Mon district in Nagaland is associated culturally and historically with colocasia as it is a traditional and less input requiring widely cultivated crop. Colocasia was known to serve as the staple food even during famine, and it is the most important food item after rice, hence attention is needed for the exploration and conservation of its genetic diversity. Future research on colocasis genotypes should integrate traditional knowledge, modern breeding techniques, climate smart agriculture to develop resilient , nutritious and high yielding varieties with fewer economic losses to farmers , it will help in value addition and processing opportunities. Through this market development resulting in income generation, our local farmers of Nagaland in general and Mon district in particular will be benefitted.

REFERENCES

REFERENCES

Akwee, P.E., Netondo, G. and Palapala, V.A. 2015. Comparative analysis of phenotypic characterization of Kenya and Pacific Islands tarogen germplasm collections. Colocasia esculenta L. Schott. *Scientia Agriculturae*. **92**(2): 113=119.

Al-jibouri N A, Miller P A and Robinson H F. 1958. Genotype and environment variances, covariances in an upland cotton cross of interspecific origin. *Agronomy Journal.* **50**: 633-637.

Alam, S., Lizelda, D., Bora, P., Kalita, P. and Saikia, A. 2014. Low cost storage of taro (*Colocasia esculenta* var. *antiquorum*) cormels. *Journal of Root Crops*. **40** (2): 66-69.

Andreas, W. E. and Logotonu, M. W. 2018. Conserving and sharing taro genetic resources for the benefit of global taro cultivation : a core contributor of the centre for pacific crops and trees. *Biopreservation and Biobanking***16** (5): 361-367

Angami,T., Jha, A.K., Juri, B, Deka and Bidyut, D. 2019. Evaluation of taro (Colocasia esculenta L.) cultivars for growth, yield and quality attributes. *Journal of Horticultural Sciences.* **10** (2) : 183-189.

Ankit, P., Kumar, A., Kushwaha, M.L. and Verma, P. 2017. Studies on genetic variability in different genotypes of taro. *Journal of Hill Agriculture*. **8** (3): 274-278.

A.O.A.C. 1984. Official Methods of Analysis 14^{th} Educational Association of Official Analytical Chemist, Washington D.C.

Asomani, A. N., Aboagye, L.M., Osei-Kofi, P.S., and Asiedu-Darko, E. 2017. Germplasm collection and ethnobotany of taro (*Colocasia esculenta* L. Schott) from nineteen districts in the Ashanti, Eastern and Western regions of Ghana.CSIR-Plant Genetic Resources Research Institute, Bunso, Ghana. *Ghana Journal of Agricultural Science*. **51**: 53-61.

Awokoya, K. N., Moronkola, B. A. and Tovide, O. O. 2012. Characterization of starches from Red Cocoyam (*Colocasia esculenta*) and White Cocoyam *(Colocasia antiquorum*) cormels. *Food Science and Quality Management***5**: 2224-6088.

Bammite, D. Matthews, P.J., Dagnon, D.Y., Agbogan, A., Odah, K., Dansi, A and Tozo, K. 2018. Agro morphological characterization of taro (*Colocasia esculenta*) and yautia (*Xanthosoma mafaffa*) in Togo, west Africa. *African Journal of Agricultural Research*. **13**(18): 934-945.

Beyene, T. M. 2013. Morpho-agronomical characterization of Taro (*Colocasia esculenta*) accessions in Ethiopia. *Plants.***1**(1): 1-9.

Bhaskar, A. V., Sikander, A. and Rahman M A. 2003. Effect of storage conditions on dry rot disease (*Fusarium solani*) in colocasia. *Journal of Research ANGRAU*.**31**(4): 78-80.

Bhuiyan, M.A.J. and Quadir, M.A. 1989. Crop duration effect on growth and yield contributing components of taro (*Colocasia esculenta* L). *South Indian Horticulture*. **37:** 235-236.

Bishop, D.L. 1991. Photosynthetic capacity, leaf size and plant height in wheat (*Triticum aestivum* L.). *All graduate Thesis and Dissertations*. 6767.

Boampong, R., Aboageye, L. M., Nyadanu, D and Esilfice, M. 2018. Agro-morphological characterization of some taro (*Colocasia esculenta* L. Schott) germplasm in Ghana. *Journal of Plant Breeding and Crop Sciences*. **10** (8): 191-202

Burton G W. 1952. Quantitative inheritance in grasses. Proc.6th International Grassland Congress **1**: 227-83.

Cheema, D. S., Singh, H. Ajmer, D and Naveen, G. 2007. Studies on genetic variability and correlation for yield and quality traits in Arvi (*Colocasia esculenta (*L.) Schott). *Acta Horticulture*.**752**: 255-260.

Chinelo, A. E., Okeke, C. U., Amadi, J. E., Izundu, A. I., Bibian, O. A., Egboka, P. T. and Udechukwu, C. D. 2015. Morphological Comparison of Five Varieties of *Colocasiaesculenta* L. Schott in Anambra State, Southeastern Nigeria. *American Journal of Plant Sciences*.**6**: 2819-2825.

Chopra, R. N., Nayar, S. L. and Chopra, I. C., 1956. Glossary of Medicinal Plants. CSIR, New Delhi. India. p. 330.

Davies, E. M., Maryke, T. L., Elizma, K., Ibrahim, R. M., Benesi , John, D and Saka, K. 2008. Some properties of starches from cocoyam (*Colocasia esculenta*) and cassava (*Manihot esculenta* Crantz) grown in Malawi. *African Journal of Food Science*. **2**: 102-111.

Deka, B.C., Thirugnanavel, A., Patel, R.K. and Deshkukh, N.A. 2012. Horticultural diversity in northeast-India and its improvement for value addition. *Indian Journal of Genetics and Plant Breeding*.**72**(2): 157-167.

Dewey, O. R. and Lu, K. H. 1959. Correlation and path coefficient analysis of components of central wheat grass seed production. *Journal of Agronomy*.**57**: 515-18.

Dimbeshwar, D. Kangkan, D. and Bijoy, N. 2014. Diversity of Aroids (Araceae) in Nazira sub-sivision, Sivasagar (Assam). *Indian Journal of Plant Sciences.* **3**(2): 35-41.

Dwivedi, A. K. and Sen, H. 2001. Comparative study on some local taro (*Colocasia esculenta*) cultivars of West Bengal. *Horticultural Journal*.**14**(2): 149-53.

Edison, S., Sreekumari, M. T., Pillai, S. V. and Sheela, M. N., 2003. Diversity and genetic resources of taro in India. In 3rd Taro Symposium.85-88.

Emmanuel, P., Nicolas, Y., Hussain, R., Gaiani, C., Joel, S. and Carl, M. F. 2014. Physicochemical and Rheological Properties of Taro (*Colocasia esculenta*) flour affected by cormels weight and method of peeling. *Food and Bioprocess Technology*. 7(5) May.

Fan-Kui, Z, Hong, L and Gang, L. 2014. Physicochemical properties of starch extracted from *Colocasia esculenta* L. Schott (Bun-long taro) grown in Hunan, China. *Research On Starch-Starke.***66**(1-2): 142-148.

Fred, B., Makeati, U., and Pago, P. 2011. Crop profile for taro in American Samao. ASCC Land Grants Program. http://www.nass.usda.govt census

Ginwal, H. S. and Mittal, N. 2010. An efficient genomic DNA isolation protocol for RAPDand SSR analysis in *Acorus calamus* L. *Indian Journal of Biotechnology*. **9**: 213-216.

Gul, S., Hanan, A., Hussai, S., and Shah, M. 1990. Suppression of sprouting in potato during storage through chemicals. *Sharhad Journal of Agriculture.***6**(4): 381-384.

Huang Chien-Chun, Chen Woan-Chin and Wang Chiun-C. R.2007. Comparison of Taiwan paddy and upland cultivated taro (*Colocasia esculenta* L.) cultivars for nutritive values. *Food Chem*. **102**: 250-256.

Janseens, M. 2001. Crop production in tropical Africa. *Bonn, Germany: Institut fur obstund germusebau, abt. Tropicscher pflanzenbau, rheinische friedrich-wilhelms-Universitat Bonn, auf dem hugel***. 6**: 221-228.

Jannatul Md, F., Munsen, E.C., Aline, F and Roberta, C. 2023. Taro Roots: An Underexploited Root Crop. *Nutrients*. **15**(15): 337

Jirarat, T., Sukruedee , A. and Pasawadee, P. 2006. Chemical and Physical properties of flour extracted from Taro (*Colocasia esculenta* L. Schott) grown in different regions of Thailand. *Science Asia.***32**: 279-284.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. 1955. Genotypic and Phenotypic correlation in soyabean and their implications in selection. *Agronomy Journal.***4**7: 477-483.

Jolly, S.N. Shanta, N, A, and zahed, U. M. Khan. 2010. Quantification of heterotrophic Bacteria and *Azospirillum* from the Rhizophere of Taro (*Colocasia esculenta* L. Schott) and the Nitrogen fixing potential of isolated *Azospirillum. International Journal of Botany***. 6**: 117-121.

Juri, B., Angami, T., Choudhary, B. U., Singh, P., Bhatt, B. P., Thirugnanavel, A, Bidyut, C. and Deka. 2013. Quality Evaluation of Indigenous Taro (*Colocasia esculenta* L.) Cultivars of Nagaland. *Indian Journal of Hill Farming.***26**(2): 16-20.

Karina, R. R., Edith, G. M., Maira, S. C., Mariela, R. J., Jesus, L. L, Irma, L. M. and David, B. A. 2016. Physicochemical and Nutritional Characterization of Starch isolated from *Colocasia antiquorum* cultivated in Oaxaca, Mexico. *Journal of Chemistry*. Article ID 6721418.

Khush, J., Fariah, R. and Shefali, T. 2023. A review on pharmacological activities of *Colocasia esculenta*. *Research Journal of Pharmacognosy and Phytochemistry*. **15**(2): 125-132

Khatemenla, J., Alam, S., Deepa, B., Phookan, Prakash, K., Madhumita, B. and Talukdar, 2019. Morphological characterization of some upland taro (*Colocasia* I L. Schott) cultivars of Northeast India. *International Journal of Current Microbiology and Applied Sciences.* 8(06): 1944-1964.

Konwar, S. 1994. Evaluation of quality and shelf life of three taro cultivars under various storage methods. M.Sc. (Agri.) Thesis, Assam Agricultural University, Jorhat.

Kreike, C. M., Van Eck, H. J and Lebot, V. 2004. Genetic diversity of taro [*Colocasia esculenta* (L.) Schott], in Southeast Asia and the Pacific. *Theoretical andApplied Genetics.* **109**(4): 761–768.

Kritika, G., Ashwani, L, Vidisha, T., Vikas, K. and Mona, S. 2019. Potential of colocasia leaves in human nutrition: Review on nutritional and phytochemical properties. *Journal of Food Biochemistry*. **43**(7): 12878.

Lebot, V., Hartati, S., Hue, N.T., Viet, N.V., Nghta, N.H., Okpul, t., Pardales, J., Prana, M.S., Prana, T.K., Thongjiem, M., Krieke, C.M., Van, H.J.E., Yap, T.C, Ivanic, A. 2010. Characterizing taro using isozymes and morphoagronomic descriptors in the Global Diversity of Taro; Ethnobotany and Conservation. *Bioversity International*. 35-55.

Lewu, M.N., Mulidzi, A.r., Gerrano, A.S. and Adebola, P.O. 2017. Comparative growth and yield of taro (*Colocasia esculenta*) accessions cultivated in the western cape, South Africa. *International Journal of Agriculture and Biology*. **19**: 589=594.

Lloyd, G. R., Akane, U and Roslyn, M. G. 2021. Effect of salinity on growth and nutrition of Taro (*Colocasia esculenta*): Implications for food security. *Plants*. **10**(11): 2319.

Magdalena, G. and Dariusz, M. 2018. Losses during storage of potato varieties in relation to weather condition during the vegetative period and temperature during long term storage. *American Journal of Potato Research*. **95**(3): 130-138.

Maninder, K., Pragati, K. and Kawaljit, S. 2013. Studies on physicochemical and pasting properties of Taro (*Colocasia esculenta* L.) flour in comparison with a cereal, tuber and legume flour. *Journal of Food and Science Technology.***50**(1): 94-100.

Manisha, C.H., Momin, Surajit, M., Alemmoa, R.J. and Miranda, K. 2021. Evaluation of physicochemical properties in different cultivars of taro (*Colocasia esculenta*. L. Schott): A comparative study. *The Pharma Innovation Journal.***10** (7):1644-1649.

Manvendra, S and Yadav, G.C. 2018. Correlation and path coefficient analysis for yield and horticulture traits in different genotypes of colocasia (*Colocasia* *esculenta*var. *antiquorum* L. Schott). *Journal of Pharmacognosy and Phytochemistry*.1: 288-292.

Manzano, A.R., Nodals, A.A.R, Gutierrez, M.I.R., Mayor, Z.F. and Alfonso, L.C. 2018. Morphological and isoenzyme variability of taro (*Colocasia esculenta* L. schott) germplasm in Cuba. *Plant Genetic Resources Newsletter*. 126:31-40.

Matthews, P.J. 1991. A possible Tropical wild type Taro (*Colocasia esculenta* var. aquatilis) Indo Pacific Prehistory Association. Bulletin. 11: p 69-81

Mitra, S., Sinha, B., Pal, H. and Tarafdar, J. 2007. Comparative studies on morphological characters, yield, nutritional status and isozymes activity of some elite genotypes of taro (*Colocasia esculenta* L. Schott var. *antiquorum*) grown in West Bengal. *Acta Horticulture.***752**:35.

Moy, J. M. and Nip, W. R. 1983. Processed Food In Taro (Ed Wang, J K) University Hawaii Press, Honululu. pp: 261-300.

Mwenye, O.J. 2009. Genetic diversity analysis and nutritional assessment of cocoyam genotypesin Malawi. M.Sc thesis submitted to university of the freestate Bloemfontein, South Africa.

Mwenye, O., Labschagne, M, T., Herselman, L., Benesi , I. R. M. and Chipungu, F. P. 2010. Ethno-botanical and morphological characterisation of cocoyams (*Colocasia esculenta* L. Schott and *Xanthosoma sagittifolium* L. Schott) germplasm in Malawi. *Department of Plant Sciences Second RUFORUM biennial Meeting20-24, Entebbe, Uganda.*

Nadkarni, K. M. 1927. Indian Meteria Medica.Nadkarni and Co, Bombay.

Obetta, S. E., Ijabo, O. J. and Satimehin, A. A. 2007. Evaluation of a ventilated underground storage for cocoyams (taro). Agricultural Engineering International : The CIGR Ejournal. Manuscript FP 07017. Vol. IX.

Okpul, T., Singh, D., Gunua, T. and Wagih, M. 2004. Assessment ofdiversity using agro-morphological traits for selecting acore sample of Papua New Guinea taro (*Colocasiaesculenta*) collection. *Genetic Resources and Crop Evolution*. **51**(6):671–678.

Opata, P. and Ogbonna, P. 2015. Storage profitability and effectiveness of storage methods in yield loss reduction in cocoyam in southeast Nigeria. *African Journal of Agricultural Research.***10**(49): 4496-4504.

Orji, K. O., and Ogbonna, P. E. 2015. Morphological Correlation Analysis on some agronomic traits of Taro (*Colocasia esculenta*) in the plains of Nsukka, Nigeria. *Journal of Global Biosciences.***4**: 1120-1126.

Ovono, P. O., Kevers, C. and Dommes, J. 2010. Effects of storage conditions on sprouting of microtubers of yam (*Dioscorea cayenensis, D. rotundata complex*). *Comptes Rendus Biologes.* **333**(1): 28-34.

Panse, V. G. and Sukhatme, P. V. 1978. Statistical Methods for Agricultural Workers. ICAR, New Delhi.

Paul , K.K., Bari, M.A. 2011. Estimates of genetics components for yield and related traits in cocoyam. *A scientific journal of Krishi Foundation, the Agriculturists*.**10**(2): 127-132.

Pena, R. S. 1970. The edible aroids in the Asian Pacific area. *2nd Symposium of International Society for Tropical Root Crops.***1**: 136-140.

Plucknett, D. L. 1970. The status and future of the major edible aroids, *Colocasia*, *Xanthosoma*, *Alocasia*, *Cyrtosperma* and *Amorphophallus*. *2nd International Symposiumon tropical root and tuber crops*. **1**: 127-135.

Pranabjyoti, S. 2007. Biometrical studies in Colocasia (*Colocasia esculenta* L. Schott) germplasm. A Ph.D Thesis submitted to Nagaland University, Department of Horticulture, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema, Nagaland.

Pratibha, S., Aparna, D. and Lava, K. K. 2013. Physico-chemical properties of six varieties of taro (*Colocasia esculenta* L. Schott) flour. *The Asian Journal of Experimental Chemistry* **8**(1&2): 7-11.

Ramdeen, K., Khatemenla and Alam, S. 2019. Genetic variability among taro (*Colocasia esculenta* L. Schott var. *antiquarum*) germplasm related to morphological and nutritional characters. *Journal of Pharmacognosy and Phytochemistry*. **8**(3): 1210-1213.

Ramdeem, K., Alam, S., Phookan, D.B., Barua, N. S., Prakash, K and Partha, J.B. 2023. Morphological characterization of some colocasia (*Colocasia esculenta* L. Schott) genotypes of north-east India. *Biological Forum-An International Journal.***15**(6) : 159-16.

Ranganna, S. 1979. Manual of analysis of Fruits and Vegetables Products. pp: 94-102. Tata Mc. Graw Hill Publishing Company Ltd., New Delhi.

Rao, C. R.. 1952. Advanced Statistical methods in biometrical research. John Wiley and son inc, New York.

Ridwan, D., Edi, S. and Candra, B. 2023. The effect of the taro corm type and storage on morphological deterioration and early growth in the field. *International Journal of Agronomy*.Volume 2023: Article ID 3280339.

Sangeeta., Devaraju, H.M., Latha, G.K. and Arunkumar, B. 2023. Evaluation of taro (*Colocasia esculenta* .L) genotypes for growth, yield and quality attributes under the hill zone of Karnataka. *Biological Forum- An International Journal*. **15** (1): 36-41

Sajeev, M. S., Manikanta, M. R., Kingsly, A. R. P., Moorthy, S. N. and Sreekumar, J. 2004. Texture analysis of taro (*Colocasia esculenta* L. Schott) cormels during storage and cooking. *Journal of Food Science.* **69**(7): 315-321.

Sajeev, M. S., Manikanta, M. R., Kingsly, A. R. P., Moorthy, S. N. and Sreekumar, J. 2006. Texture analysis of taro cormels during storage and cooking. *Journal of Food Science.* **99**(7): 315-321.

Sarmah, I.1997. Performance of some colocasia under different spacings. M.Sc (Agri) Thesis, AAU, Jorhat, Assam, India.

Sen, S., Mandal, N., Majumdar, D. and Pal, S. 2003. Compositional changes in cormels during tuber development of *Colocasia esculenta*. *Journal of Interacademicia.***7**(1):25-30.

Setyawan, H. B., Roni, Y., Oviaki, Z and Listya, P. 2021. Potential of three taro (*Colocasia esculenta* L.) cultivars as animal feed. *Asean Journal of Science and Technology for Development.* **38**(38): 97-102.

Singh, D., Mace, E., Okpul, T., Godwin, I., Mathur, P. N., Taylor, M. B., Kambuou, R., Rao, V. R. and Hunter, D. 2002. Collection, characterization and conservation of taro (*Colocasia esculenta*) genetic resources for efficient utilization in breeding. In 12th Australasian Plant Breeding Conference(1). p. 251-253.

Singh, D., Mace, E. S., Godwin, I. D., Mathur, P. N., Okpul, T., Taylor, M., Hunter, D., Kambuou, R., Rao, V. R. and Jackson, G. 2008. Assessment and rationalization of genetic diversity of Papua New Guinea taro (*Colocasia esculenta*) using SSR DNA fingerprinting. *Genetic Resources and Crop Evolution*. **55**(6): 811-822.

Sivasubramanian, J and Madhavamenon, P. 1973. Genotypic and phenotypic variability in rice. *Madras Agricultural Journal.***12**: 15-16.

Srinavasa, V., Sangeeta and Devaraju, H. M. 2021. Studies on genetic variability, correlation coefficient and path coefficient analysis for growth and yield attributes in taro (*Colocasia esculenta* L.). *The Pharma Innovation Journal*. **10** (12): 1508-1513.

Sufia, B., Habibur, R., Rahim, M.A and Abu, Z, A.M. 2024. Screening and morphological characterization of taro (*Colocasia spp*). *Indian Journal of Horticulture* .**81** (2): 123-128.

Talwana, H. A. L., Serem, A. K., Ndabikunze, B. K., Nandi, J.O. M., Tumuhimbise, R., Kaweesi, T., Chumo, E. C. and Palapala, V. 2009. Production status and prospects of cocoyam (*Colocasia esculenta* (L.) Schott.) in East Africa. *Journal of Root Crops.* **35** (1): 98-107.

Tadik, M., Moses, N. and Kigwe, S. 2023. Genetical studies on agro morphological characters of some taro (*Colocasia esculenta* L. Schott) cultivars of northeast India. *Journal of Agricultural Science.* **57**(3) : 381-386.

Taylor, M., Hunter, D., Rao, V. R., Jackson, G. V. H., Sivan, P. and Guarino, L. 2010. Taro collecting and conservation in the Pacific region. *The Global Diversity of Taro*. pp 150-167.

Tewodros. 2013. Morpho-agronomical characterization of taro (*Colocasia esculenta*) accessions in Ethiopia. *Plant.* **1**:1-9.

Tewodros, L. and Tilahun, B, 2021. Evaluation of improved taro (Colocasia esculenta L. Schott) genotypes on growth and yield performance in North-bench woreda of bench-sheko zone, south- Western Ethiopia. *Heliyon*. **7**:12.

Thejazhanuo, L. M., Sapu, C, Pattanayati, A., Chaturvedi, H., Vimala, D. and Pravas, R. K. 2012. Genetic characterization of locally cultivated taro germplasm from eleven district of Nagaland, India. *International Journal of Current Microbiology and Applied Sciences.***6**(8): 3338-3348.

Thirugnanavel, A., Bidyut, C. D., Lily, R. and Martha, C. 2013. Genetic diversity of Taro (*Colocasia esculenta* L.) in Mon district, Nagaland, needs attention for its conservation. *Current Science.* **105** (8): 1036-1037.

Thirugnanavel, A., Deka. B. C., Rangnamei, L., Meyase, M. and Patel, J.K. 2015. Colocasia and its genetic diversity in northeast India. Technical bulletin published by Director, ICAR Research Complex for NEH Region, Barapani Meghalaya.

Thirugnanavel, A., Bidyut, D., Lily, R and Sethraman, S. P. 2022. Colocasia (*Colocasia esculenta* L.) in Northeast India. *Journal of Innovative Agriculture*. **9** (1): 1-7.

Velayudhan, K. C., Liji, R. S. and Rajlakshmy, C. 2000. Correlation and path analysis in taro morphotypes. *Journal of Root Crops.***26**(2): 36-39.

Vijayabhaskar, A., Rahman, M. A., Sikander, A. and Rao, K. C. S. 2004. Effect of different storage methods on soft corm rot disease in colocasia. *Journal of Research ANGRAU*. **32**(4): 105-110.

Vinutha, K. B., Asha Devi, A. and Sreekumar, J. 2015. Morphological Characterization of above ground characters of Taro (*Colocasia esculenta* L. Schott) accessions from North East India. *Journal of Root Crops.***41**(1): 3-11.

Wills Ron, B.H., Lim Jessie, S.K., Greenfield Heather and Bayliss- Smith Tim. 1983. Nutrient composition of taro (*Colocasia esculenta* L) cultivars from the papua New Guinea highlands. *Journal of the Science of Food and Agriculture*. **34**: 1137-1142.

Wright, S. 1921. Correlation and Causation. *Journal of Agricultural Research.***20**: 557-585.

Yen, D. E. and Wheeler, J.M. 1968. Introduction of *Colocasia esculenta* into the Pacific. The indication of the chromosome number. *Ethnology*. 7: 259-267.

Yamaguchi, M., 1983. Edible Aroids: Taro, Yautia, and Others.*InWorld Vegetables*. Springer,Dordrecht, pp.148-157.

Yared, D. and Tewodros, M. 2014. Exploring indigenous knowledge and production constrains of taro (*Colocasia esculenta* L. Schott) cultivars grown at dalbo watershed, woltaita zone of South Ethiopia. *Green Journal of Plant Breeding Crop Science.***2**(3): 47-53.

APPENDICES

Appendix I: Collection of genotypes from farmers of different regions of Mon district

Appendix II: Collection of genotypes from farmers of different regions of Mon district



Appendix III: Collection of genotypes from farmers of different regions of Mon district

Appendix IV: Collection of genotypes from farmers of different regions of Mon district

Appendix V : Collection of genotypes from farmers of different regions of Mon district

Appendix VI: Collection of genotypes from farmers of different regions of Mon district

Appendix VII: Harvesting of colocasia at experimental field

Appendix VIII: Research work