ROOT AND SHOOT GROWTH OF GRAPEVINE (Vitis vinifera L.) CUTTINGS AS AFFECTED BY ROOTING MEDIA AND VARIETIES

By

LAWAL, ABDU BAMIDELE

A Thesis Submitted to the Postgraduate School
Ahmadu Bello University, Zaria
In partial fulfillment of the requirement of the degree of
Master of Science in Agronomy.

DEPARTMENT OF AGRONOMY
FACULTY OF AGRICULTURE
AHMADU BELLO UNIVERSITY
ZARIA
NIGERIA

December, 1993

DECLARATION

I hereby declare that this thesis has been written by me and that it is a record of my own research work. It has not been presented before in any previous application for a higher degree.



.....

Lawal Abdu Bamidele

(M.Sc/Agric/5361)

The above declaration is confirmed



.....

Prof. M.K. Ahmed

(Major Supervisor)

CERTIFICATION

This thesis entitled "Root and Shoot growth of grapevine (Vitis vinifera L.) cuttings as affected by rooting media and varieties" by LAWAL, ABDU BAMIDELE meets the regulations governing the award of the degree of Master of Science of Ahmadu Bello University, and is approved for it's contribution to Scientific Knowledge and literary presentation.

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DEDICATION

This work is dedicated

To

my **Mum**

(Hadjia K.A. Lawanson)

and to as many parents who struggle

to provide for their children.

ACKNOWLEDGEMENT

It is with more than mere formality that I thank Prof. Mohammed Kursheed Ahmed, my major Supervisor, for his unceasing assistance, guidance and valueable comments without which this work may not have been suddesful.

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Lawal A.B.

December, 1993

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ABSTRACT

Investigations were carried out at the Institute for Agricultural Research farm, Samaru, Zaria during the 1992 dry season to determine the effect of rooting media on root and shoot growth of varieties of grapevine (Vit is vinifera L.). Three experiment were conducted using fresh, 3 and 6 weeks callused cuttings . Treatmnts consisted of seven rooting media as main-treatments and eleven varieties of grapevine as subtreatments laid out in a split plot design replicated six times. In all the three experiments Anab x American seedling was observed to have an edge over all the other varieties tested with respect to apical and basal shoot length, shoot fresh and dry weights, number of leaves per cutting. Leave area number of roots, root volume, root fresh and dry weights and basal shoot girth among among other vegetative characters studied. In the rooting media treatment, the rooting media, potting mixture III (75% sand, 12.5% FYM, 12.5% Topsoil) 100% ricehull and potting mixture II (50% sand, 25% FYM, 25% Topsoil) resulted in the best performance in fresh, 3 and 6 weeks callus cuttings respectively.

CHAPTER ONE

INTRODUCTION

Grapevine (Vitis vinifera L.) is grown extensively in many parts of the world both for wine making and as table grapes. Grapes occupy far more land in the world than any single fruit, and in production, accounts for nearly half of the total world production of all fruits (Singh et al, 1967). The world total vineyard as at 1992, occupied an area of 10 million hectares which yielded 65 million tonnes, an average of 6.5 tonnes/ hecatares (FAO, 1993). In 1992, the mean annual output of wine which is the principal product was 500 million hectolitre. The production of table grapes consumed as fresh fruits is about 10 metric tonnes, while that of raisins__largely sundried fruits of seedless varieties was about 1 metric tonne.

Within Africa, grapes are grown extensively throughout Southern Africa, Zimbabwe and the Malagasy Republic. Smaller vineyards exist in Ethiopia, kenya, Tanzania, Mozambique and Malawi. No statistics is available for any of the countries in West Africa sub-region (Karikari, 1984). It is known however, that the grape industry in West Africa has only recently arisen out of the activities of amateur growers, but the way it has been taken up by Lebanese, Indian expatriates and commercial firms, particularly in Nigeria and Ghana, it will not be too long before FAO tables present production figures from West Africa.

Grapes are potentially one of the most important fruits in the tropics for fresh consumption, drying into raisins and wine making. Ripe grapes are very easily digeted. They contain a larger proportion of sugar and useful minerals. Varieties good for eating as fresh fruits are refered to as table grapes. Most of the varieties grown in Nigeria are table grapes, though there are a few which are good for making excellent juice and wine. Seedless varieties though palatable when eaten as fresh fruits, are better dried, preserved and eaten as raisins. Alcoholic beverages may also be made from wine grapes. Grape juice is a nourishing thirst-quencher, a stimulant to the kidney and a laxative which can be bottled for subsequent use (Singh et al, 1967).

Graevine is adapted to a wide range of soil types. The crop does better on light friable soil than on stiff compact clay. Vineyard soil must be well drained, shallow, loamy and range from 76-91cm in depth (Singh et al, 1967). Grapes do not generally thrive in regions of humid summers whether temperature or tropical, as moisture in the air during the cropping season cause fungal diseases on the leaves and fruits.

The most serious problems experienced with grape growing in tropical Africa concerns diseases, pest problems, establishment and lack of research to identify suitable varieties. In some tropical areas, grapes do not become dormant naturally due to insufficient cold temperatures.

Nutritive Value (Percentage) of Grapevine

Moisture	85.5
Vitamin C (mg/100g	3
Protein	0.8
Fat (either extract)	0.1
Mineral matter	0.4
Fibre	3.0
Carbonhydrate	10.2
Calcium	0.03
Phosphorus (p)	0.02
Iron (Fe)	0.4
Calorific value per 100g	45
Carotene (per 100g)	15
Vitamin B (mg/100g)	40
Nicotinic acid (mg/100g)	0.3
Riboflavin (mg/100g)	10

In these areas, dormancy is induced by pruning and leaf removal twice each year. The first pruning is carried out just before the start of the rainy season. The following growth will produce a few fruits; however, this is usually not a large commercial crop. At the end of the rains, the process if repeated, fruits are then borne during the dry season under irrigation. Fruits ripening during dry weather is less likely to develop fruit rot than that ripening during the rainy season.

Grapes seems to have been introduced into Nigeria by Christian Missionaries from Europe and Hajj pilgrims from the Middle-East (Ahmed et al, 1982; Ratnam, 1982). Hitherto, grapevine was grown almost exclusively in the gardens of the Missionaries and in Emirs palaces, with little or no success due to inadequate care. The hidden potentials of grapes production was not discovered in Nigeria until 1966, when the then Federal Department of Agriculture invited U.S. Agency for international development horticultural consultants to advice it on the cultivation of a range of tropical and subtropical fruit trees (Tappan, 1966).

The production of grapes in Nigeria has improved since the 1980's as a result of the demand for it by companies like the Nigerian Bottling Company, Vegfru and Zaria Agro-industries (Karikari, 1984) individuals all over the Northern states where the climate is favourable for

grapevine growth, private food companies, state governments etc have gone into commercial cultivation of grapes.

The prospect of grapevine growing in Nigeria is great, especially in the relatively dry Northern states. The cold harmattan season is similar to the mediterranean climate which is suitable for fruiting of grapes. This moderate climate with no rigour of winter enables the grapevine take unimpeded growth throughout the year without a prolonged unproductive dormant phase characteristic of vineyards in temprate regions (Hulme, 1971). This makes possible, the harvest of two crops a year by judicious manipulation of pruning unlike the single crop harvestable in the temprate grapes growing regions of the world.

Inspite of the diversity of materials tested, there has been amazingly little work done on the physical characteristics of the rooting media in relation to the rooting and establishment of cuttings. It is generally agreed that with comparatively heavy application of water involved in propagation, a rapidly draining, well aerated medium is essential. The difficulty in obtaining good soil for propagation and in disease control have led to an interest in artificial rooting media. This interest is not new as many potential media such as peatmoss, sawdust, coconutshell, cotton waste and rice-hull were studied as early as the 1930s in Holland and the 1940s in California

(Muijzenberg and Baker, 1972). Coarse sand, river sand etc are very vague terms, and different types of peat vary considerably in their physical characteristics and chemical composition. If useful comparisons are to be made between the results of various trials therefore, the water holding capacity and air/water relations would have to be more precisely specified. This warrants further studied on the effects of these factors on the shoot and quality of roots growth.

Objectives

This investigation was conducted to:

i. Study the effect of rooting media and varieties on root and shoot growth of grapevine.

ii. Study the interaction between rooting media and varieties on root and shoot growth of grapevine.

2.0. LITERATURE REVIEW

2.1. Propagation

Grapes may be propagated from seeds with great difficulty as seed germination is very poor. In addition plant propagated by seeds are not true-to-type and differ markedly from their parent vines and from each other. Also the plants produced by seeds take much longer to bear fruit (5-7 years). Therefore seed propagation of grape is impracticable for vineyards. Due to the long usage of vegetative propagation, grape seeds have lost their viability and in some varieties these seeds are not even produced at all, as in the case of seedless varieties (Hartmann and Kester 1978). Weaver, (1976) reported that fertilization is essential for the production of berries though the seeds abort immediately after fertilization, hence rudimentary seeds are found in berries.

Propagation by vegetative means like cuttings, layering and buds or grafts in contrast produces vines identical with the parent vine in all varietal characteristics (Wrinkler et al, 1962). Grapevine is propagated commercially by cuttings, buds or grafts (Weaver, 1976). For the cuttings, segments of dormant canes are almost always used. The vines can be easily propagated from woody cuttings using specialized green house technique like mist chamber (Wrinkler et al, 1962).

2.2. Propagation by Use of Cuttings

Hartmann and Kester, (1978) observed that nearly all grape varieties are propagated by cuttings. These are normally grown in the nursery for 6 to 12 months to produce roots and young vines before transplanting. Umaru, (1990) however reported occasional planting of unrooted grape cuttings directly in vineyards.

For commercial production of grape cuttings, dormant matured canes are almost always used. The length of cuttings used for nursery planting varies from 15-25cm and at least 3-4 nodes are included. The thickness of the cutting range between 1.25 - 2cm (Weaver, 1976). The top is cut slanting at an angle of 45", for easy identification of the upper end and to avoid polanty effect. The lower cut is often straight and as close to the lowest bud as possible. The basal cut is usually just below a node and the top cut 1.5-2.5cm above a node (Hartman and Kester, 1978).

2.3. Influence of Substrates on the formation and growth of roots in cuttings

Cuttings are planted in a suitable substrate, the composition and structure of which should maintain optimum aeration, humidity and temperature around the base of the cutting. Diverse materials are used as substrates; sand of various kinds, peat of various origins, different earth mixtures, vermiculite, old sawdust, and water.

When deciding on the composition of the substrate, it is essential to know the biological features of the plant. Thus, cuttings of Indian azalea and tree heath root well and develop a vigorous root system under conifers or a mixture of peat and sand in equal proportions by volume, under a thin layer of sand (about 1.5cm) (Komissaiov, 1964).

The development of roots in cuttings of Japanese camellia, which grows on acid soils, proceeds better when there is an earth mixture with an addition of acid peat under a thin layer of sand. In cuttings of common box, which grows on soils rich in lime, the roots develop well in an earth mixture with a neutral or slightly alkaline solution.

Data from Petyaev (1949)'s experiment showed cuttings of olive tree to root well in coarse calcereous sand from the seashore. Hitchcock and Zimmerman (1926) and Hitchcock (1928) carried out experiments to examine influence of different substrates on the rooting rates of cuttings. They divided all plants into three groups according to the capacity of their cuttings to root in different substrates.
In the first group of plants, he placed those of which the cuttings root better in peat than in sand; Azalea amoeno, Vaccinium corymbosum and Ilex crenata. In the second group were plants of which the cuttings root well in sand and poorly in peat; Berberis thomberogii, Lagerstroemia indica and L. Japonicum. In the third and largest group were plants of which the cuttings root well in peat as well as in

sand e.g. Ilex cornuta, I. opaca, Lonicera tatarica and Taxus cuspidata most plants of the third group also root well in mixture of equal parts of peat and sand.

Nearing (1958) came to the conclusion that the most favourable substrate for rooting should have a lower layer of substrate which is distinguished by a high water-holding capacity, whereas the upper layer provides a sufficient inflow of oxygen from the air to the lower end of the cutting. Experiments by Komissarov (1964) showed that cuttings of a vast group of coniferous, evergreen or decidous trees and shrub, root well in coarse-grained sand under which there is a nutritive mixture of light sandy loam soil and well decomposed low peat. The experiments also established the importance of the method of distribution of substrates and nutrient mixture. In cuttings of several coniferous and foliate species the roots are directed downward at an angle and usually emerge through the callus. In this instance, the cuttings are planted in the sand layer of a mixture of sand and peat, under which there is a nutritive mixture for root growth.

Optimum conditions for the initiation of adventitious roots in cuttings do not always coincide with favourable conditions for root growth. This must be taken into account when choosing the substrate for rooting the cuttings and nutritive mixture for root growth. The kind of rooting medium used for propagation affects the type of rooting system arising from cuttings. Plants difficult to root may

be greatly influenced by rooting medium, not only in the percentage of cuttings rooted, but in the quality of the root system formed. Cuttings rooted in sand, produced too long, unbranched, brittle root system in contrast to more desirable fibrous and branched root systems developed in other media (Anderson and Kinners 1949).

Adriance and Brison (1968) reported that loose sandy loam soil with good drainage is most suitable for cuttings planted directly into the nursery such as figs, grapes and roses. In an experiment conducted at the department of environmental horticulture university of California using two rooting media: peat: vermiculite (1:1 by volume) and very coarse sand, it was observed that the rooting media significantly affected rooting percentages and the type of root system produced.

All cuttings in coarse sand rooted in 24 days but only 60% of those in peat: vermiculite had rooted by this time. Although rooting was faster in sand, the root produced were finer and less numerous than those in peat: vermiculite (James and Davids, 1985). Workers at East malling and in Holland, have found that establishment after rooting was better when the cuttings had been rooted in a peat/sand mixture than when pure sand was used, but at Edinburgh Botanic garden, cuttings transplanted better from a medium of sand than from a 4.1 mixture of vary coarse sand and peat (Rowe-Dutton, 1959). Adriance and Brison (1968) claimed that cuttings of plants

that root poorly when placed in sand, often root satisfactorily in a mixture of equal volumes of sand and peat. The superiority of this medium over sand for certain species is probably due to improved duration and increased water holding capacity. Generally, the more sand there is in a rooting medium mixture, the more vigorous the callus formation and the slower the root formation. With the addition of peat, callus is reduced with the attendant increase in rooting rate (Wells, 1957). Oliver and Nelson (1958) asserted that peatmoss is often added to sand in varying proportions mainly to increase the water holding capacity of the mixture.

Water has long been used for small scale rooting of cuttings of easily propagated species, the great disadvantage is the lack of aeration. Tests have shown that by artificially aerating water with oxygen or air, excellent rooting of cuttings of some species can be obtained (Wells, 1957). Sheat (1948) reported that in aerated water, the best roots are formed near the basal end of the cuttings, whereas in non-aerated water, the best roots are produced near the surface of the water where the oxygen content is higher.

It is difficult to choose a particular medium as the best for propagation of cuttings as each has it's own particular short comings. The conifer, Chamasarparis requires a mixture of nearly 70% peat and 30% sand to root properly while this mixture will contain altogether too much

peat for Chamaecozpaois allumii, which requires not more than 30% peat (Wells, 1957). While in an experiment to test growth response of Capsicum spp to various propagation media, Olaniyan and Fawusi (1990) found topsoil and a mixture of topsoil and poultry manure to significantly improve plant height, leaf number and total dry weight.

2.4. The Formation of Callused and it's Physiological Role in the Life of the Cutting

Tissues on the wound surface of the cutting are regenerated through the formation of a tumourous outgrowth refered to as callus. The physiological role of callus in the life processes of cutting and in root formation have not been sufficiently studied. Different views have been published on this question. Buryi (1901), Hartmann and Kester (1978), Flerov and Kovalenko (1952) and Hartmann and Kester (1978) believed that callus plays an important role in the supply of water to the cuttings in the rooting process. Van der Lek (1925) and Wells (1957) considered that root formation in cuttings is not connected with the activity of callus while Akhundzade (1951) came to the conclusion that callus hinders the formation of adventitious roots.

Callus develops mainly through the activity of cambium. The participation of other living tissues is related to the degree of lignification and the general age condition of the

cutting. For instance in little lignified cutting of myrtle, nearly all the living tissues of bark, wood and pith take part in the formation of callus. In lignified cuttings of this plant, however, callus develops only through cambial activity. Therefore, to begin with, the callus has the shape of a ringlike roll which with growth, gradually covers the entire surface of the cutting (Komissarov, 1964).

In semilignified cuttings of large leaved lime, in addition to the cambium, pith and wood cells (chiefly from the medullary rays) take part in the formation of callus. Komissarov, (1964), found that in semilignified cuttings of English oak, mountainous camellia, common box, Japanese spindle tree and Japanese aucuba, callus develops from the dividing cells of cambium and pith. In cuttings of the same plants with a greater degree of lignification, callus develops out of cambium only. Similarly, callus development in relation to the degree of lignification is seen in several other coniferous, broadleaved evergreen ad decidious species. Severova (1958), established the influence of plant age on callus development and reported that in softwood cuttings from young plants of warty-barked spindle tree any cells of the pith parenchyma, the medullary rays or the cambium can begin the formation of callus. In cutting from adult trees, callus usually develops only out of cambial tissues.

Komissarov (1964) reported that the duration of callus growth and its size and shape depend on the species, the size of the cuttings, their nutrient content, the beginning of root initiation and finally on external conditions. As a rule, the more nutrients there are in the cuttings and the slower the roots are formed, the more the callus develops, and the more substantial it becomes. On the other hand, the earlier the roots appear and the greater their number, the sooner does the callus stop growth. In cuttings of cryptomeria-like Taiwania, Arizona crypress and some other conifers which have no roots, callus may grow for 2-3 years (as long as the cutting lives). In softwood cuttings, the developed callus is small and either a spherical or a mushroom shape, whereas as in lignified cuttings it reaches a large size and is shaped like a grapes.

Callus may be formed not only on the surface of the lower and upper cuts of stem of the cuttings but also in the lenticels and bark sometimes advertitious roots are initiated in such poorly developed callus. This has been observed by Zhironkin (1951) in winter cuttings of willow and black currant of which the lower ends were immersed in water.

Komissarov, (1964) reported that generally, the beginning of differentiation of callus tissues and the degree of their development depend on the species of plant, the condition of the cuttings and the external conditions, particularly the composition of the substrate, its

temperature, humidity and aeration. In cuttings of several plants that root in water, callus develops normally but less intensely than in moist sand. He also claimed that cuttings of red escallonia and large-leaved hydrangea root very well in water but the callus does not develop at all.

Flerov and Kovalenko (1952) reported that excessive growth of callus may inhibit the initiation of adventitious roots, but this does not always happen. In experiments with Japanese camellia and common lilac some cuttings with large callus root well, others not at all. The same is also true among cuttings with poor callus, some of which remain without roots. They therefore, concluded that root formation in cuttings depend not on only the degree of callus development but on other conditions as well. Severova (1958) claimed, the very early appearance of roots may prevent callus development; this is often observed after treating the cutting with growth stimulants. He observed that the absence of normally developed callus allows infection of the wound by fungi with fatal consequences to the plants propagated by cuttings. There is therefore no reason for excessive forcing of root formation in cuttings. On the other hand, it is inadviseable to allow an excessive development of callus at the expense of the timely appearance of roots.

Komissarov (1964) reported that the developed callus is covered on the outside with a protective tissue, usually cork, deposited by the suberous phellogen. The protective

tissues of the callus of many plants, e.g. common Yew, Arizona cypress, and taiwania, are impregnated with pigments. These tissues are slightly permeable to water. Therefore, even if there is a well-developed conductive system, the callus absorbs and conducts water very poorly into the stem and leaves of the cuttings. He claimed that the amount of water absorbed by the callus is quite insignificant in comparison with the amount expended by the leaves.

On the basis of the above, it can be considered that callus plays an important part in the life of the cutting, particularly if roots are initiated in it. However, the characteristics of development and structure of the callus and consequently its physiological role in cuttings of various plant species and even in the same species may differ depending on the age of the maternal plants, the condition of the cuttings, and the rooting conditions.

2.5. Significance of Buds and Leaves in the Formation of Roots in Cuttings

Vander Lek (1925) pointed out the existence, in some cases, of a correlative connection between the buds and the formation of roots in cuttings. The removal of all buds on leafless cuttings of black currant and grapevine led to a delay in the appearance of roots and a reduction in their number. The removal of buds on leafless cuttings of willow

and poplar had less effect on root formation than in cuttings of black currant and grapevine, but it was noticeable all the same.

Zimmerman and Hitchcock (1928) established that in certain cuttings without buds, thick, weakly branching roots develop. Priestley and Swingle (1929) share Van der Lek's (1925) opinion that there is a relationship between the buds and the formation of roots in cutting, but consider that the nature of this relationship remain unclear. On the basis of his experiments on the rooting of winter cuttings of a very large number of tree and shrub species, Kemp (1948) came to the conclusion that in most cases, the opening buds do not have a positive influence on root formation. On the contrary, the rapid opening of buds in slow-rooting cuttings leads to nagative results due to the exhaustion of nutrients required for the growth of shoots it is therefore important to delay the opening of buds and to speed up the initiation of roots in such cuttings.

Kemp's (1948) experiment showed that winter cuttings of grapevine root well when the buds are in a state of deep dormancy. Cuttings of Salix daphnoides with dormant buds also rooted well in November. According to Pravdin (1944), cuttings of Salix clasycladoa taken on 1st August, 1st September and 1st October do not root in water, whereas those taken on 1st November root well. Apparently the period of deep dormancy in this willow species occurs in

August - September. On the basis of the experiment, it may be concluded that various plant species have a different capacity for propagation by cuttings during the period of deep dormancy.

Van der Lek (1925) assumed that buds secrete one or several hormones which more towards the base of the stem of the cutting and cause root formation there. The nature of these hormones is however not known. The initiation and development of roots in summer cuttings is connected with leaf activity. As a result of carbon assimilation in the light, sugars and other organic substances are formed in the leaves and move along the phloem into the lower part of the cutting where they are used for nutrition, growth and reproduction of cells. The premature shedding or artificial removal of leaves usually have a nagative effect on the process of root formation in cuttings. Leafy cuttings of Coleus, carnation, and chrysanthemum root better and later on develop better than cuttings without leaves (Riehle, 1958). Rakitin's research (1947) shows that in Solanum lycopersicum L. roots develop sooner and more intensively on girdled stem parts with leaves than on parts without leaves. Dostal (1956) considers that growing leaves and those that have just ended their growth stimulate root formation in the cutting, whereas old leaves hinders it. In this case, roots appear on the stem on the opposite side of the leaf.

Some authors (Went, 1929; Bouillenne and Went 1933; Cooper, 1936; Galston 1948) argue that the positive role of leaves in root formation of cuttings is chiefly explained by their capacity to produce the root forming hormone - rhizocaline. Went explained that the poor rooting of cuttings by their deficiency in rhizocaline without which, allegedly no root primodia may be initiated. Komissarov (1964) however opined that Bouillenne and Went's (1933) hypothesis is quite groundless, as no rhizocaline has ever been isolated. The nature of the cell rhizogenesis factor-enzyme is also unknown. Naturally, the physiological nature of the action of these unknown substances cannot be established either.

CHAPTER THREE

MATERIALS AND METHODS

Three experiments were conducted to test seven rooting media on eleven varieties of grapes in the Institute for Agricultural Research farm, Ahmadu Bello University, Samaru, Zaria, during the 1992 dry season using fresh, 3 and 6 weeks callus cuttings.

3.1. Experimental Site

The experimental site is located on latitude 11°.12', 07 37'E, 686 meters above sea level in the Nothern Guinea savannah ecological zone of Nigeria. The detail climatic elements for the experimental season is given in appendix I.

3.2. Treatment and Experimental Design

The treatment consist of seven rooting media (shown in appendix II) as main treatment and Eleven varieties of grapevine (shown in appendix III) as subtreatments, laid out in a split plot design replicated six times. For easy description of the different proportions of rooting media, the first three media will be abbreviated as; PMI, PMII and PMIII respectively. PMI is a mixture of (25% sand, 37.5% FYM, 37.5% Top soil), PMII (50% sand, 25% FYM, 25% Top soil), and PMIII (75% sand, 12.5% FYM, 12.5% Top soil).

The rooting substrates which are the maintreatments were held in 10 litre size plastic buckets leaving space at the top for watering, the plastic buckets were provided with drainage perforations at the bottom on which small pieces of pebbles were placed to prevent loss of the media through the perforations.

The canes of various varieties of grapes which are the subtreatments were labelled and planted randomly into the rooting substrates. Immediately after prunning, the canes were defoliated and planted fresh into the first experiment, other cuttings were defoliated and callused in tissue paper and moistened with luke warm water as and when necessary, to induce callus formation and prevent infection. These cuttings were callused for three (3) and six (6) weeks and planted as above as per the layout plan.

3.3. Preparation of planting material

The top and base of pruned vines were avoided when making cuttings, as the top is not physiologically mature and lacks reserve material to produce roots, and the base is too old and exhausted to produce good roots, therefore cuttings were prepared from the centre portion of pruned vines. Each cutting which had 3-4 buds, was prepared by giving straight cut close to basal nodes. At the top, a slanting cut of about 45 degrees is given about 1cm away from the bud to avoid any damage to the top bud by desiccation. The cuttings were then planted into rooting media in slanting position.

3.4. Cultural Practice

3.4.1. Weed Disease and Pest Control

Weeds were controlled by hand pulling weeds.

No disease or pest attack was observed. The crop maintained a healthy, luxuriant appearance throughout the period of the experiment.

3.5. Parameters Studied

Data were collected at 2,5,8 and 11 weeks after planting (WAP) to determined the character described hereunder.

3.5.1. Number of leaves

The number of leaves per cutting were counted and recorded at 2,5,8 and 11 weeks after planting.

3.5.2. Total leaf Area

Total assimilatory surface at termination of experiment (11 WAP) was measured after harvesting using leaf area meter, model L1-3000 of Lambda Instrument Co.

3.5.3 Area per leaf

Total leaf area per cutting divided by the total number of leaves produced by each cutting.

3.5.4. Leaf fresh weight

Leaf fresh weight per cutting was recorded at 11 WAP by harvesting all leaves on each cutting and weighing.

3.5.5. Leaf dry weight

Leaves collected from each cutting at eleven weeks after planting were oven dried, and weighed at intervals of 48 hours till they attained a constant weight .

3.5.6. Shoot length

Shoot length was measured weekly from the point of attachment to the mature cane, to the tip of the shoot, using a transplant ruler. The shoots originating from the upper and lower buds of the cane are refered to as apical and basal shoots respectively and measured seperately. Though shoot length was measured weekly from 1 to 11 WAP, only data for 2,5,8 and 11 WAP are presented in this text.

3.5.7 Shoot fresh weight

Shoots were detached carefully using a pair of scissors and weighed at eleven weeks after planting.

3.5.8 Shoot dry weight

Shoot were oven dried and weighed repeatedly after every 48 hours till they attained a constant weight.

3.5.9 Number of roots

The roots of the cuttings were flushed out of the experimental pots using strong water jet from the tap after harvesting the shoot(s). The roots were then counted carefully.

3.5.10 Root length

The root length per cutting was measured by the use of a string, the string was later measured with a transparent ruler.

3.5.11 Root fresh weight

Fresh root were detached from cuttings using a pair of scissors and then weighed.

3.5.12 Root volume

The roots were immersed in known volume (25 mls) of water in a measuring cylinder, the initial volume was later subtracted from the final.

3.5.13 Root dry weight

The detached roots were oven dried and weighed repeatedly after every 48 hours till they attained a constant weight.

3.5.14. Shoot girth

The shoot girth was measured at the point of attachment to the mature cane, and at the shoot tip. These were recorded as basal and apical shoot girths respectively.

3.5.15 Shoot volume

Shoots were immersed in known quantity (50 mls) of water in measuring cylinder, the initial volume was later subtracted from the final.

3.6. Statistical Analysis of Data

The data collected were subjected to statistical analysis of variance as described by Snedecor and Cochran (1967). Significant differences among the treatment means were evaluated using Duncan multiple range test (Duncan, 1955).

CHAPTER FOUR

RESULTS

4.1. Total Leaf Area

The leaf area (mm^2/plt) as affected by rooting media and varieties at 0,3 and 6 weeks after callusing is shown in table 4.1a and the corresponding analysis of variance (ANOVA) is given in table 4.1b.

Analysis of data on rooting media revealed that mean leaf area which was recorded at 11 weeks after planting (WAP) was found to be highly significant in 0 and 6 weeks callus treatments. For fresh cuttings, PmIII and sand produced higher leaf area than all other media on trial except Sawdust, while in 6 weeks callus experiment, PmII resulted in higher leaf area than all other media tested except PmI and grit.

When the varieties were considered, the result was highly significant for all the periods of callusing. In trials with fresh and 6 weeks callus cuttings, the hybrid Anab x American produced higher leaf area than other varieties under trial. While in 3 weeks callus treatment, Bangalore blue produced significantly higher leaf area than the rest of the varieties tested.

The interaction between rooting media and varieties was found to be highly significant for the fresh and 3 weeks callus trials. When the interaction for fresh

Table 4.1a: Leaf Area (mm^2) as affected by rooting medium and variety in grapes during the 1992 dry season.

Treatments	Uncallused cutting	callused period (wks) 3	6
Rooting media			
Soil: FYM: Sand 37.5% 37.5% 25%	355c	120	395ab
Soil: FYM: Sand 25% 25% 50%	81c	481	610a
Soil: FYM: Sand 12.5 12.5% 75%	1927a	347	251bc
Sand (100%)	1783a	770	174bc
Grit (100%)	869bc	782	311abc
Rice-hull (100 %)	720bc	833	2c
Sawdust (100%)	1327ab	945	1c
SE ±	254.8	218.1	114.4
Significance	**	NS	**
Variety			
Anab-e-shahi	853cde	825bc	99bcd
Anab x American	2850a	205cd	994a
Bangalore blue	988b-e	2035a	106bcd
Black hamburgh	176b	825bc	355bcd
Cardinal	183ef	716bcd	1d
Catawaba	1156bcd	139cd	475cd
Ex-Zaria Black	346def	1039b	124bcd
MKM-7	835cde	251cd	549b
Regina	491def	559bcd	25cd
Thompson Seedless	1f	1d	1d
Queen Golden	1626bc	128cd	13cd
SE ±	263.8	236.6	145.0
Significance	**	**	**
Interaction			
Rooting medium x variety			
Significance	**	**	NS

Means followed by the same letter(s) within a treatment gr
for a specific callus period are not significant statistica
at 5% probability.
** = Significant at 1 percent level
NS = Not significant

Table 4.1b: Analysis of variance for total leaf area (mm^2) at the 3 callusing periods.

		Uncallused cutting		Callused period (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	4.301	1.47	4.354	1.85	14507	1.64
R.media	6	3.228	7.53	5.969	1.90	31183	3.61
Error (a)	30	4.284	1.46	3.140	1.33	86342	0.97
Varieties (V)	11	2.868	9.81	1.444	6.14	41758	4.72
Int. M x V	10	6.310	2.16	4.969	2.11	74845	0.84
Error (b)	350	2.922		2.349		88311	

4.1c: Leaf Area for fresh cuttings as affected by interaction of Rooting medium and variety in grapes during 1992 dry season

	Main Tr. / Sub. Tr.	100 percent of Grit	Sand	S/Dst.	R/Hull	Percent Composition of T/Soil / F.Y.M. / Sand	37.5 / 37.5 / 25.0	25.0 / 25.0 / 50.0	12.5 / 12.5 / 75..0
1.	Aneb-e-Shahi	293hi	2336c-h	586e-i	1i		744d-i	454f-i	1556c-i
2.	AnebxAmer Sed.	2933b-g	6465a	2994b-f	1596c-h		518f-i	180i	5260ab
3.	Bang. Blue	2308c-h	34i	2047c-h	251i		504f-i	232i	1539c-h
4.	Bl. Hambourg	2154c-h	3901abc	1741c-h	1139d-h		303hi	1i	3139c-e
5.	Cardinal	313hi	1i	561e-i	1i		405ghi	1i	1i
6.	Catawaba	114i	2921b-g	985d-h	1695c-h		144i	1i	2230c-h
7.	Ex-Zaria Bl.	427f-h	878d-i	505f-i	1i		212i	1i	401ghi
8.	MKM-7	709d-h	63i	3241bcd	386ghi		1i	19i	1430c-h
9.	Regina	301hi	1886c-h	843d-h	1i		1i	1i	401
10.	Thm. Seedless	1i	1i	1i	1i		1i	1i	1i
11.	Queen Golden	10i	1131d-h	1091d-h	2843b-h		1076d-h	1i	5234ab

Interaction SE± 712.6

Means followed by the same letter(s) within a treatment for a specific callus period are not significant statistically at 5% probability.

4.1d: Leaf Area for 3 weeks Callused Cutting as affected by Interaction of Rooting Medium and Variety in Grapes during 1992 Dry Season

	Main Tr.	100 percent of				Percent Composition of		
	Sub. Tr.	Grit	Sand	S/Dst.	R/Hull	T/Soil	37.5	25.0	12.5
						F.Y.M.	37.5	25.0	12.5
						Sand	25.0	50.0	75.0
1.	Anab-e-Shahi	999def	1f	4513a	262ef		1f	1f	1f
2.	Anab x Amer Sed.	1f	1f	1f	1f		1f	1088def	339ef
3.	Bang. Blue	3829abc	4251ab	2321a-e	2089b-f		1f	1238def	514ef
4.	Bl. Hambourg	607ef	1f	1f	663ef		1226def	1048def	2228a-f
5.	Cardinal	1189def	2020b-f	1f	1798c-f		1f	1f	1f
6.	Catawaba	1f	1f	1f	1f		88ef	872def	7f
7.	Ex-Zaria Bl.	1970b-f	1315def	929def	3046a-d		1f	9f	1f
8.	MKM-7	1f	1f	1f	1f		1f	1034def	720ef
9.	Regina	1f	872def	1735c-f	1304def		1f	1f	1f
10.	Thm. Seedless	1f	1f	1f	1f		1f	1f	1f
11.	Queen Golden	1f	1f	1f	1f		1f	1f	1f

Interaction SE' 635.3

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

cuttings was perused (Table 4.1c), significant difference among the varieties for leaf area production was noticed in all the media studied except PMII. When the variety was examined in different media, there was differential response in all the varieties tested except cardinal Ex-Zaria black and Thompson seedless. A higher leaf area was produced by Anab x American seedlings in sand, followed by the same variety and Queen golden in PmIII and Black hamburgh in sand in that order which constituted a non-significant group.

Interaction for the 3 weeks callus experiment (Table 4.1d) showed no significant difference among all varieties for leaf area production in the three potting mixtures (I-III). When the same variety was studied in different media there was differential response by Anab-e-shahi, Bangalore blue and Ex-Zaria-black higher leaf area for 3 weeks callus trial was produced by the varieties Anab-e-shahi in sawdust, Bangalore blue in sand, grit and sawdust, Ex-Zaria black in rice-hull and Black hamburgh in PmIII. They all constituted the same non-significant group.

4.2. Area per leaf (mm^2)

The effect of rooting media and varieties on area per leaf(mm^2/plt) at 0, 3 and 6 weeks after callusing is shown in table 4.2a and the corresponding analysis of variance (ANOVA) is given in table 4.2b.

Table 4.2a: Area per leaf (mm^2) as affected by Rooting medium and variety in grapes during the 1992 dry season:

Treatments	Uncallused cutting	callused period (wks) 3	6
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	44b	17	71ab
Soil: FYM: Sand (25% 25% 50%)	31b	73	107a
Soil: FYM: Sand (12.5% 12.5% 75%)	178a	46	50abc
Sand (100%)	191a	117	32bc
Grit (100%)	113ab	89	67ab
Rice-hull (100%)	146ab	176	1c
Sawdust (100%)	184a	131	1.5c
SE ±	37.77	36.50	18.15
Significance	*	NS	**
Varieties:			
Anab-e-Shahi	229ab	1d	15c
Anab x American seedling	227ab	304a	191a
Bangalore blue	154abc	51cd	22c
Black hamburgh	109c	211ab	54bc
Cardinal	66c	1d	1c
Catawaba	92bc	177b	97b
Ex-Zaria Black	56c	1d	26c
MKM-7	84bc	129bc	97b
Regina	48c	1d	9c
Thompson Seedless	39c	1d	1c
Queen Golden	290a	140bc	5c
SE ±	45.47	33.88	24.17
Significance	**	**	**
Interaction:			
Rooting medium x Variety			
Significance	**	**	NS

Means followed by the same letter(s) within a treatment group for particular character are not significant statistically at 5 percei probability. * and ** = significant at 5 and 1 percent NS = n significant.

Table 4.2b Analysis of variance for area per leaf (mm^2) at the 3 callusing periods.

		Uncallused cuttings		Callused period (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	102555	1.18	47057	0.97	39501	1.61
R.media	6	291790	3.09	190037	2.16	98567	4.53
Error (a)	30	94201	1.08	87806	1.81	21730	0.88
Varieties (V)	10	310083	3.56	473803	9.81	148666	6.06
Int. M x V	60	123622	1.42	69538	1.44	22987	0.93
Error (b)	350	86931		48260		24516	

4.2c: Area per leaf (mm^2) for fresh cuttings as affected by the Interaction of Rooting medium and variety in grapes during the 1992 dry season.

	Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	S/Dst.	R/Hull	T/Soil F.Y.M. Sand	Percent Composition of: 37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.
1.	Anab-e-Shahi	158b-e	540ab	269b-e	80de		40e	39e	480b-d
2.	Anab x Amer Sed.	521bc	319b-e	396b-e	147b-e		81de	37e	85c-e
3.	Bang. Blue	192b-e	319b-e	183b-e	16e		43de	33e	294b-e
4.	Bl. Hambourg	144b-e	97b-e	278b-e	207b-e		34e	1e	1e
5.	Cardinal	1e	254b-e	81de	1e		1e	1e	125b-e
6.	Catawaba	8e	157b-e	169b-e	150b-e		55de	1e	101c-e
7.	Ex-Zaria Bl.	114b-e	32e	89c-d	1e		17e	10e	128b-e
8.	MKM-7	95c-e	1e	32b-e	27e		1e	1e	136b-e
9.	Regina	1e	197b-e	135b-e	1e		1e	1e	1e
10.	Thm. Seedless	1e	62d-f	1e	1e		1e	1e	206b-e
11.	Queen Golden	5e	120b-e	100c-e	969a		214b-e	218b-e	403b-e

Interaction SE± 120.37

Means followed by the same letter(s) within a treatment group for a particular character are not *significant statistically at 5 percent probability.*

4.2d: Area per leaf (mm^2) for the 3 weeks callused cutting as affected by interaction of Rooting medium and variety in grapes during the 1992 dry season.

	Main Tr.	100 percent of				Percent Composition of		
		Grit	Sand	S/Dst.	R/Hull	T/Soil	37.5	25.0	12.5
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5
						Sand	25.0	50.0	75.0
1.	Anab-e-Shahi	1g	1g	1g	1g		1g	1g	1g
2.	Anab x Amer Sed.	448a-d	575a	329a-g	147b-e		1g	201b-f	32fg
3.	Bang. Blue	39fg	1g	115d-g	16e		1g	140c-f	59e-g
4.	Bl. Hambourg	214b-g	1g	360a-f	207b-e		154c-g	176c-g	285a-g
5.	Cardinal	1g	1g	1g	1e		1g	1g	1g
6.	Catawaba	210b-f	172c-g	454a-c	150b-e		23fg	192c-g	3g
7.	Ex-Zaria Bl.	1g	1g	1g	1e		1g	4g	1g
8.	MKM-7	1g	382a-e	183c-g	27e		1g	80e-g	121c-g
9.	Regina	1g	1g	1g	1e		1g	1g	1g
10.	Thm. Seedless	1g	1g	1g	1e		1g	1g	1g
11.	Queen Golden	58e-g	128c-g	337a-g	454a-c		1g	1g	1g

Interaction SE± 93.00

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Statistical analysis of data on rooting media revealed that mean area per leaf was significant at 5% level for the fresh cuttings, and highly significant in the 6 weeks callus experiment.

The rooting media sand, sawdust and PMIII yielded larger mean area per leaf than PMI and II in trials with fresh cuttings while in experiments with 6 weeks callus cuttings, higher mean area per leaf was given by PMII compared with other media under trial with the exception of PMI, grit and PMIII.

When the varieties were considered the difference among varieties in the three periods of callusing was found to be highly significant. At 0 callusing, the variety Queen golden produced higher mean area per leaf compared with all other varieties tested except Anab-e-shahi, Anab x American and Bangalore blue. When cuttings were callused for 3 and 6 weeks, the hybrid Anab x American seedlings yielded larger mean area per leaf than all other varieties tested except Black hamburgh in the 3 weeks callus experiment where area per leaf produced by Anab x American seedling was statistically at par with that given by Black hamburgh.

A study of the interaction between rooting media and varieties showed that the interaction was highly significant for both the fresh and 3 weeks callus studies (Tables 4.2c and 4.2d). Close perusal of the result of interaction in experiments with fresh cuttings revealed

significant difference among the varieties for mean area per leaf production in all the media trial except PMI and II. When the same variety was examined in different propagating media, differential responses were exhibited by Anab-e-shahi, Anab x American seedling, Ex-Zaria-black, and Queen golden. The variety Queen golden in rice-hull produced higher leaf area than all others except Anab-e-shahi in sand.

Interaction for 3 weeks callus trial showed significant differences among the varieties for area per leaf production in all media tested except PMI and III. When the same variety was studied in the different media, there was no differential response to mean area per leaf in the varieties Anab-e-shahi, Cardinal, Ex-Zaria black, Regina and Thompson seedless. Higher mean leaf area was recorded by the hybrid Anab x American in sand, sawdust, Queen golden in rice-hull, Anab x American in grit, MKM-7 in sawdust, Black hamburgh in rice-hull, Queen golden in sawdust, Anab x American in rice-hull and Black hamburgh in PMIII in that order and which constituted a non-significant group.

4.3 Leaf fresh weight

The leaf fresh weight (g/plt) as affected by rooting media and varieties at 0,3 and 6 weeks after callusing is given in table 4.3a and the corresponding analysis of variance (ANOVA) is shown in table 4.3b.

Table 4.3a: Leaf fresh weight (g) as affected by Rooting medium and variety in grapes during the 1992 dry season.

Treatments	Uncallused cutting	callused period (wks) 3	6
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	1.67dc	1.01	1.14ab
Soil: FYM: Sand (25% 25% 50%)	1.15d	1.10	1.19a
Soil: FYM: Sand (12.5% 12.5% 75%)	2.25ab	1.12	1.06bc
Sand (100%)	2.44a	1.25	1.04bc
Grit (100%)	1.73bc	1.26	1.07abc
Rice-hull (100%)	1.50cd	1.32	1.00c
Sawdust (100%)	1.83bc	1.14	1.00c
SE ±	0.18	0.08	0.04
Significance	*	NS	**
Varieties:			
Anab-e-Shahi	2.01bc	1.00d	1.03b
Anab x American seedling	2.09b	1.62a	1.26a
Bangalore blue	3.05a	1.11cd	1.03b
Black hamburgh	1.65bc	1.29bc	1.11ab
Cardinal	2.05bc	1.00d	1.00b
Catawaba	1.29c	1.36b	1.13ab
Ex-Zaria Black	1.77bc	1.02d	1.05b
MKM-7	1.43bc	1.18bcd	1.14ab
Regina	1.33bc	1.00d	1.05b
Thompson Seedless	1.30bc	1.00d	1.05b
Queen Golden	1.82bc	1.32b	1.00b
SE ±	0.24	0.07	0.05
Significance	**	**	**
Interaction:			
Rooting medium x Variety			
Significance	**	**	NS

Means followed by the same letter(s) within a treatment group for particular character are not significant statistically at 5 perce probability. * and ** = significant at 5 and 1 percent leve respectively NS = not significant.

Table 4.3b Analysis of variance for leaf fresh weight (g) at the 3 callusing periods.

		Uncallused cuttings		Callused period (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	6.406	2.75	0.262	1.43	0.145	1.65
R.media	6	12.694	6.21	0.798	2.09	0.326	3.44
Error (a)	30	2.044	0.88	0.381	2.08	0.095	1.07
Varieties (V)	10	11.120	4.78	1.733	9.49	0.269	3.06
Int. M x V	60	4.102	1.76	0.268	1.46	0.087	0.99
Error (b)	350	2.323		0.183		0.088	

Table 4.3c: Leaf fresh weight (g) for the fresh cutting as affected by Interaction of Rooting medium and variety in grapes during the 1992 dry season.

	Main Tr.	100 percent of					Percent Composition of		
	Sub. Tr.	Grit	Sand	S/Dst.	R/Hull	T/Soil F.Y.M. Sand	37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0
1.	Anab-e-Shahi	2.26cd	4.95ab	1.33d	1.03d		2.40cd	1.00d	1.00d
2.	Anab x Amer Sed.	2.39	4.07	2.46	2.27		1.98	2.19	2.40
3.	Bang. Blue	1.23d	3.10b-d	2.75b-d	1.00d		2.01cd	1.45d	6.69a
4.	Bl. Hambourg	2.31cd	2.01cd	2.05cd	1.01d		1.57d	1.00d	1.58d
5.	Cardinal	3.02b-d	2.70b-d	1.41d	1.60d		1.76d	1.00d	2.82b-d
6.	Catawaba	1.21d	1.87cd	1.68d	1.00d		1.26d	1.00d	1.00d
7.	Ex-Zaria Bl.	1.35d	2.48cd	1.38d	2.10cd		1.26d	1.00d	2.82b-d
8.	MKM-7	1.00d	1.00d	2.91b-d	1.00d		1.00d	1.02d	2.06cd
9.	Regina	1.66d	1.06d	1.55d	1.67d		1.00d	1.00d	1.35d
10.	Thm. Seedless	1.63d	2.26cd	1.00d	1.00d		1.00d	1.00d	1.20d
11.	Queen Golden	1.00d	1.36d	1.67d	2.74b-d		3.13b-d	1.00d	1.85cd

Interaction SE± 0.62

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.3d: Leaf fresh weight (g) for 3 weeks callused cutting as affected by the Interaction of Rooting Medium and Variety in grapes during the 1992 dry season.

	Main Tr. / Sub. Tr.	100 percent of Grit	Sand	S/Dst.	R/Hull	T/Soil F.Y.M. Sand	Percent Composition of 37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.
1.	Anab-e-Shahi	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f
2.	Anab x Amer Sed.	2.73a	2.11a-c	1.61b-f	1.77b-e		1.00f	1.25ef	1.31d-f
3.	Bang. Blue	1.29d-f	1.00f	1.00f	1.12ef		1.00f	1.24ef	1.09f
4.	Bl. Hambourg	1.33d-f	1.52c-f	1.00f	1.48c-f		1.00f	1.09f	1.52c-f
5.	Cardinal	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f
6.	Catawaba	1.89b-d	1.55b-f	1.23ef	1.56b-f		1.02f	1.23ef	1.01f
7.	Ex-Zaria Bl.	1.00f	1.00f	1.00f	1.00f		1.00f	1.13ef	1.00f
8.	MKM-7	1.00f	1.21ef	1.20d-f	1.48c-f		1.00f	1.20ef	1.09f
9.	Regina	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f
10.	Thm. Seedless	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f
11.	Queen Golden	1.11f	1.35d-f	1.35d-f	2.17ab		1.00f	1.00f	1.24ef

Interaction SE± 0.18

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Statistical analysis of data for the rooting media revealed that mean leaf fresh weight was highly significant at 0, not significant at 3 weeks callused period and significant at 5% level for 6 weeks callus period. For the fresh cuttings, sand was found to produce significantly higher leaf fresh weight compared to other media tested except PMIII. This was followed by Sawdust which was statistically at par with grit. This was followed by PMI which is also statistically same with rice-hull and PMI.

When the mean of 6 weeks callused experiment were compared, it was observed that PMII resulted in highest leaf fresh weight which was statistically at par with PMI and grit.

When varieties were considered, the difference were highly significant in all the 3 periods of callusing. In trials with fesh cuttings, the variety Bangalore blue produced the highest leaf fresh weight which was significantly higher than all other varieties under trial. This was followed by Anab x American seedling which is statistically at par with cardinal, Anab-e-shahi, Queen golden, Ex-Zaria black, Black hamburgh, MKM-7, Regina and Thompson seedless. For the 3 weeks callus cuttings
Anab x American gave heaviest fresh leaves compared with other varieties under trial. This was followed by catawaba. The difference among the mean leaf fresh weight of Catawaba, Queen golden, Black hamburgh and MKM-7 was not significant.

The 6 weeks callus trial showed Anab x American seedling to produce heaviest fresh leaves which was similar in terms of statistical significance with Black hamburgh, catawaba and MKM-7. All the other varieties fall into a non-significant group. The interaction between rooting media and varieties was found to be highly significant for both the 0 and 3 weeks callused trials Tables 4.3c and 4.3d respectively. When the interaction at 0 callusing was critically observed, it was noted that there was no significant difference among all the eleven varieties for the production of leaf fresh weight, in potting mixtures I and II, grit, sawdust and rice-hull. A differential response of varieties to the production of leaf fresh weight was found in sand and PMIII in which Anab-e-shahi and Bangalore blue recorded the highest fresh leaf weight respectively.

In 3 weeks callused trial, when the leaf fresh weight production was critically studied for different varieties in the same rooting media, the difference was insignificant for the 3 potting mixtures and sawdust. Anab x American seedling produced heavier fresh leaves in grit and sand, whereas Queen golden produced significantly higher fresh leaf weight in rice-hull.

4.4. Leaf dry weight

The effect of rooting media and varieties on leaf dry weight (g/plt) at 0, 3 and 6 weeks after callusing is shown in table 4.4a and the corresponding analysis of variance (ANOVA) is given in table 4.4b.

Table 4.4a: Leaf dry weight (g) as influenced by Rooting mediu and variety in grapes during the 1992 dry season.

Treatments	Uncallused cutting	callused period (wks) 3	6
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	1.15bc	1.01	1.05ab
Soil: FYM: Sand (25% 25% 50%)	1.03c	1.02	1.06a
Soil: FYM: Sand (12.5% 12.5% 75%)	1.26ab	1.03	1.03a-c
Sand (100%)	1.28a	1.06	1.02bc
Grit (100%)	1.12c	1.08	1.04ab
Rice-hull (100%)	1.09c	1.10	1.00c
Sawdust (100%)	1.15bc	1.03	1.00c
SE ±	0.04	0.02	0.01
Significance	**	NS	*
Varieties			
Anab-e-Shahi	1.14b-d	1.08	1.06
Anab x Amer	1.40a	1.09	1.03
Bangalore blue	1.21bc	1.03	1.03
Black hamburgh	1.25b	1.08	1.04
Cardinal	1.03d	1.04	1.00
Catawaba	1.14b-d	1.06	1.05
Ex-Zaria Black	1.05d	1.02	1.02
MKM-7	1.13b-d	1.04	1.06
Regina	1.06cd	1.02	1.02
Thompson Seedless	1.00d	1.01	1.00
Queen Golden	1.28ab	1.05	1.00
SE ±	0.05	0.02	0.02
Significance	**	NS	NS
Interaction:			
Rooting media x Variety			
Significance	**	**	**

Means followed by the same letter(s) within a treatment group for particular character are not significant statistically at 5 percer probability. * and ** = significant at 5 and 1 percent leve respectively NS = not significant.

Table 4.4b Analysis of variance for leaf dry weight (g) at the 3 callusing periods.

		Uncallused cuttings		Callused period (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	0.025	0.24	0.033	1.82	0.006	0.57
R.media	6	0.505	4.52	0.082	2.08	0.033	3.02
Error (a)	30	0.112	1.08	0.039	2.16	0.011	1.00
Varieties (V)	10	0.617	1.71	0.031	1.73	0.022	2.01
Int. M x V	60	0.111	5.97	0.030	1.68	0.012	1.06
Error (b)	350	0.103	1.07	0.018		0.011	

Table 4.4c: Leaf dry weight (g) for fresh cutting as influenced by the Interaction of rooting medium and Variety in grapes during the 1992 dry season.

	Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	S/Dst.	R/Hull	T/Soil F.Y.M. Sand	Percent Composition of: 37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0
1.	Anab-e-Shahi	1.04d	1.20cd	1.05d	1.00d		1.33b-d	1.19cd	1.18cd
2.	Anab x Amer Sed.	1.36b-d	1.90a	1.37b-d	1.19cd		1.25b-d	1.00d	1.70ab
3.	Bang. Blue	1.26b-d	1.39b-d	1.26b-d	1.00d		1.23cd	1.11cd	1.24b-d
4.	Bl. Hambourg	1.35b-d	1.54a-c	1.17cd	1.15cd		1.16cd	1.00d	1.38b-d
5.	Cardinal	1.03d	1.00d	1.06d	1.00d		1.33b-d	1.00d	1.00d
6.	Catawaba	1.05d	1.38b-d	1.08cd	1.19cd		1.07d	1.00d	1.25bcd
7.	Ex-Zaria Bl.	1.07d	1.09cd	1.06d	1.00d		1.07d	1.00d	1.05d
8.	MKM-7	1.10cd	1.02d	1.37b-d	1.14cd		1.00d	1.002d	1.23cd
9.	Regina	1.06d	1.25b-d	1.10cd	1.00d		1.00d	1.00d	1.08d
10.	Thm. Seedless	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
11.	Queen Golden	1.01d	1.35b-d	1.11cd	1.34b-d		1.45a-d	1.00d	1.35b-d

Interaction SE± 0.13

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.4d: Leaf dry weight (g) for the 3 weeks callus trial as influenced by the interaction of rooting medium and variety in grapes during the 1992 dry season.

	Main Tr.	100 percent of					Percent Composition of		
	Sub. Tr.	Grit	Sand	S/Dst.	R/Hull	T/Soil	37.5	25.0	12.5
						F.Y.M.	37.5	25.0	12.5
						Sand	25.0	50.0	75.0
1.	Anab-e-Shahi	1.35a	1.00e	1.00e	1.22a-d		1.00e	1.00e	1.00e
2.	Anab x Amer Sed.	1.18a-e	1.23a-c	1.03c-e	1.06c-e		1.00e	1.05c-e	1.11b-e
3.	Bang. Blue	1.12b-e	1.00e	1.00e	1.06c-e		1.00e	1.00e	1.03c-e
4.	Bl. Hambourg	1.01de	1.18a-e	1.00e	1.09c-e		1.00e	1.03c-e	1.18a-e
5.	Cardinal	1.20a-e	1.00e	1.03c-e	1.07c-e		1.00e	1.00e	1.00e
6.	Catawaba	1.02c-e	1.19a-e	1.07c-e	1.16a-e		1.00e	1.01de	1.19a-e
7.	Ex-Zaria Bl.	1.00e	1.00e	1.04c-e	1.05c-e		1.00e	1.08c-e	1.00e
8.	MKM-7	1.00e	1.00c-e	1.08c-e	1.05c-e		1.00e	1.08c-e	1.00e
9.	Regina	1.00e	1.00e	1.00e	1.08c-e		1.00e	1.00e	1.04c-e
10.	Thm. Seedless	1.03c-e	1.00e	1.05c-e	1.00e		1.00e	1.00e	1.00e
11.	Queen Golden	1.00e	1.01de	1.02c-e	1.31ab		1.00e	1.00e	1.00e

Interaction SE± 0.06

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.4e: Leaf dry weight (g) for the 6 weeks callused cuttings as affected by the interaction of rooting media and variety in grapes during the 1992 dry season.

	Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	S/Dst.	R/Hull	T/Soil : F.Y.M. : Sand	Percent Composition of: 37.5 : 37.5 : 25.0	25.0 : 25.0 : 50.0	12.5 : 12.5 : 75.0
1.	Anab-e-Shahi	1.09a-c	1.08a-c	1.00c	1.00c		1.20a	1.00c	1.09a-c
2.	Anab x Amer Sed.	1.00c	1.00c	1.00c	1.00c		1.00c	1.13a-c	1.09a-c
3.	Bang. Blue	1.12a-c	1.00c	1.00c	1.00c		1.00c	1.05c	1.00c
4.	Bl. Hambourg	1.00c	1.02bc	1.00c	1.00c		1.08a-c	1.20a	1.00c
5.	Cardinal	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c
6.	Catawaba	1.05bc	1.05bc	1.00c	1.00c		1.16bc	1.07a-c	1.00c
7.	Ex-Zaria Bl.	1.08a-c	1.00c	1.00c	1.00c		1.00c	1.05c	1.01c
8.	MKM-7	1.09a-c	1.08a-c	1.00c	1.00c		1.07a-c	1.13a-c	1.05bc
9.	Regina	1.01c	1.00c	1.00c	1.00c		1.00c	1.00c	1.13a-c
10.	Thm. Seedless	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c
11.	Queen Golden	1.00c	1.00c	1.00c	1.00c		1.00c	1.01c	1.00c

Interaction SE± 0.04

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Analysis of the data on rooting media revealed that mean leaf dry weight was highly significant at 0 period of callusing, not significant at 3 weeks and significant at 5% level for 6 weeks callus period. For fresh cuttings, sand was found to give significantly higher leaf dry weight when compared with all other treatments except PMIII. This was followed by PMIII which was statistically at par with both PMI and sawdust, but produced significantly higher leaf dry weight than grit, rice-hull and PMII. The difference between PMI, sawdust, grit, ricehull and PMII was insignificant statistically.

The differences in the leaf dry weight of 6 weeks callus cuttings was also significant. Potting mixture II resulted in highest leaf dry weight which was statistically same as PMI, grit, and PMIII, and it was significantly higher than sand, rice-hull and sawdust. This was followed by PMI, which resulted in higher leaf dry weight than rice-hull and sawdust. The differences between PMIII, sand, rice-hull and sawdust was not statistically significant.

When the varieties were considered, the differences were highly significant only in the experiment with fresh cuttings. The hybrid Anab x American seedling produced the highest dry leaf weight which was significantly same as Queen golden but higher than all other varieties under trial. Queen golden was found to be statistically same as Black hamburgh, Bangalore blue, catawaba, Anab-e-shahi and

MKM-7. Queen golden and Black hamburgh produced heavier dry leaves than Ex-Zaria-black, Cardinal and Thompson seedless. The difference in the leaf dry weight of the varieties catawaba, Anab-e-shahi, MKM-7, Regina, Ex-Zaria black, Cardianal and Thompson seedless was insignificant.

The interaction between rooting media and varieties was found to be highly significant at all periods of callusing when the interaction at 0 callusing (Table 4.4c) was observed critically, it was noted that there was no differecne among all the eleven varieties for production of leaf dry weight in grit, sawdust, rice-hull, PMI and II.

When the same variety was studied in different rooting media, there was differential response for Anab x American seedling and Black hamburgh. For all the varieties, the differential response due to rooting media was not statistically significant. Anab x American hybrid in sand produced heavier dry leaves than all other rooting media except PMII. Similarly the variety Black hamburgh produced more leaf dry weight than all other varieties under trial.

In 3 weeks callused trial (Table 4.4d), when the leaf dry weight was critically studied in the same rooting media for different varieties the differences were insignificant for sawdust and in all the 3 potting mixtures. When the same variety was studied in different media for dry leaf production, the varieties Anab-e-shahi, Anab x American hybrid and Queen golden showed differential response to rooting media. Anab-e-shahi produced more dry leaves in

grit and rice-hull, Anab x American hybrid in grit and Sand and Queen golden in rice-hull.

When the interaction between rooting media and varieties was critically analysed for leaf dry weight production in the 6 weeks callused trial (Table 4.4e), the rooting media - grit, Sand, Sawdust, rice-hull and PMIII did not show any differential response due to varieties.

When the same variety was examined in different rooting media the varieties Anab-e-shahi and Black hamburgh exhibited differential responses. Anab-e-shahi produced significantly higher leaf dry weight in all the media tested except Sawdust, rice-hull and PMII. While Black hamburgh gave heavier leaf dry weight in PMI and II.

4.5 Shoot girth at apical bud:

The shoot girth (cm/plt) at apical bud as affected by rooting media and varieties at 0, 3 and 6 weeks after callusing is shown in table 4.5a and the corresponding analysis of variance given in table 4.5b.

Analysis of data on rooting media revealed that the differences in shoot girth at the apical bud was highly significant for fresh cutting and significant at 5% level for the 6 weeks callus experiment. For fresh cuttings, sawdust produce higher shoot girth at the apical bud than rice-hull, PMI and PMII. In experiment with 6 weeks callus

Table 4.5a: Shoot girth (cm) at apical bud as affected by rooting media and variety in grapes during the 1992 dry season

Treatments	Uncallused cutting	callused period (wks) 3	6
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	1.14bc	1.02	1.08a
Soil: FYM: Sand (25% 25% 50%)	1.02c	1.11	1.10a
Soil: FYM: Sand (12.5% 12.5% 75%)	1.32ab	1.06	1.10a
Sand (100%)	1.32ab	1.19	1.05ab
Grit (100%)	1.26ab	1.17	1.09a
Rice-hull (100%)	1.16bc	1.18	1.00b
Sawdust (100%)	1.35a	1.15	1.00b
SE ±	0.06	0.04	0.02
Significance	**	NS	**
Varieties:			
Anab-e-Shahi	1.16c-e	1.00f	1.01c
Anab x Amer	1.64a	1.36a	1.26a
Bangalore blue	1.24cd	1.12de	1.02c
Black hamburgh	1.45b	1.29ab	1.07bc
Cardinal	1.10de	1.00f	1.00c
Catawaba	1.24cd	1.25ab	1.12b
Ex-Zaria Black	1.09de	1.01ef	1.05bc
MKM-7	1.27c	1.14cd	1.08bc
Regina	1.10de	1.00f	1.02c
Thompson Seedless	1.00e	1.00f	1.00c
Queen golden	1.19cd	1.20bc	1.00c
SE ±	0.05	0.04	0.03
Significance	**	**	**
Interaction:			
Rooting media x Variety			
Significance	**	**	**

Means followed by the same letter(s) within a treatment group for particular character are not significant statistically at 5 percen probability. * and ** = significant at 5 and 1 percent leve respectively NS = not significant.

Table 4.5b Analysis of variance for shoot grit (cm) at apical bud for the 3 callusing periods

		Uncallused cuttings		Callused period (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	0.034	0.32	0.033	0.52	0.038	1.05
R.media	6	1.000	4.85	0.293	2.26	0.127	3.18
Error (a)	30	0.206	2.01	0.130	2.06	0.040	1.12
Varieties (V)	10	1.408	13.81	0.756	12.01	0.255	7.17
Int. M x V	60	0.199	1.94	0.083	1.32	0.038	1.06
Error (b)	350	0.102		0.063		0.036	

Table 4.5c: Apical shoot girth (cm) for fresh cutting as affect by the interaction of rooting media and variety grapes during the 1992 dry season.

Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	S/Dst.	R/Hull	T/Soil / F.Y.M. / Sand	Percent Composition of: 37.5 / 37.5 / 25.0	25.0 / 25.0 / 50.0	12.5 / 12.5 / 75.0
1. Anab-e-Shahi	1.17d-f	1.33c-f	1.17d-f	1.00f		1.08ef	1.17d-f	1.17d-f
2. Anab x Amer Sed.	1.67a-d	1.97ab	2.00a	1.58a-e		1.25c-f	1.00f	2.00a
3. Bang. Blue	1.33c-f	1.08ef	1.42b-f	1.17d-f		1.33c-f	1.00f	1.33c-f
4. Bl. Hambourg	1.50a-f	1.75a-c	1.67a-d	1.33c-f		1.25c-f	1.00f	1.67a-d
5. Cardinal	1.17d-f	1.00f	1.00f	1.00f		1.17d-f	1.00f	1.33c-f
6. Catawaba	1.17d-f	1.57a-e	1.50a-f	1.25c-f		1.17d-f	1.00f	1.00f
7. Ex-Zaria Bl.	1.08ef	1.27c-f	1.17d-f	1.00f		1.08ef	1.00f	1.00f
8. MKM-7	1.58a-e	1.00f	1.67a-d	1.17d-f		1.00f	1.00f	1.50a-f
9. Regina	1.00f	1.50a-f	1.17d-f	1.00f		1.00f	1.00f	1.00f
10. Thm. Seedless	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f
11. Queen golden	1.15ef	1.08ef	1.08ef	1.27c-f		1.18de	1.00f	1.53a-e

Interaction SE± 0.14

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.5d: Apical shoot girth (cm) for 3 weeks callused trial as affected by the interaction of rooting medium and variety in grapes during the 1992 dry season

	Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	S/Dst.	R/Hull	T/Soil / F.Y.M. / Sand	Percent Composition of: 37.5 / 37.5 / 25.0	25.0 / 25.0 / 50.0	12.5 / 12.5 / 75.0
1.	Anab-e-Shahi	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
2.	Anab x Amer Sed.	1.50ab	1.50ab	1.70a	1.50ab		1.00e	1.25b-e	1.08de
3.	Bang. Blue	1.17c-e	1.00e	1.08de	1.25b-e		1.00e	1.17c-e	1.17c-e
4.	Bl. Hambourg	1.33a-e	1.58ab	1.00e	1.4a-d		1.08de	1.33a-e	1.27b-e
5.	Cardinal	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
6.	Catawaba	1.42a-d	1.25b-e	1.33a-e	1.33a-e		1.08de	1.25b-e	1.08de
7.	Ex-Zaria Bl.	1.00e	1.00e	1.00e	1.00e		1.00e	1.08e	1.00e
8.	MKM-7	1.25b-e	1.17c-e	1.25b-e	1.17c-e		1.00e	1.08de	1.08de
9.	Regina	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
10.	Thm. Seedless	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
11.	Queen golden	1.25b-e	1.58ab	1.00e	1.33a-e		1.00e	1.00e	1.00e

Interaction SE± 0.11

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.5e: Apical shoot girth (cm) for 6 weeks callused experiment as affected by the interaction of rooting medium and variety in grapes during the 1992 dry season

	Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	S/Dst.	R/Hull	T/Soil F.Y.M. Sand	Percent Composition of: 37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0
1.	Anab-e-Shahi	1.08de	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
2.	Anab x Amer Sed.	1.42a-c	1.17c-e	1.00e	1.00e		1.33b-d	1.42a-c	1.50ab
3.	Bang. Blue	1.00e	1.00e	1.00e	1.00e		1.00e	1.08de	1.08de
4.	Bl. Hambourg	1.00e	1.08de	1.00e	1.00e		1.67a	1.25b-e	1.00e
5.	Cardinal	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
6.	Catawaba	1.25b-e	1.17c-e	1.00e	1.00e		1.25b-e	1.17c-e	1.00e
7.	Ex-Zaria Bl.	1.17c-e	1.00e	1.00e	1.00e		1.00e	1.08de	1.08de
8.	MKM-7	1.08de	1.08de	1.00de	1.00e		1.08de	1.08de	1.25b-e
9.	Regina	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.17c-e
10.	Thm. Seedless	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
11.	Queen golden	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e

Interaction SE± 0.08

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

cuttings the three potting mixtures and grit produced higher shoot girth at the apical bud than rice-hull and sawdust.

When the varieties were considered, the differences were highly significant for all the callusing periods. The hybrid Anab x American seedling produced higher shoot girth at the apical bud than all other varieties tested at 0 and 6 weeks periods of callusing, however, in case of 3 weeks callus trial, the same variety resulted in higher shoot girth at the apex bud than all others except Black hamburgh and catawaba.

The interaction between rooting media and varieties was highly significant for all the callusing periods. When the interaction at 0 callusing (Table 4.5c) was examined, there was differential response of varieties when compared in all the media tested except PMII. When the same variety was looked at in different media there was differential response in case of Anab x American seedling, Black hamburgh, catawaba, MKM-7 and Queen golden. The highest shoot girth at the apex bud was recorded by: In case of Anab x American hybrid in PMIII, sawdust, sand, grit and rice-hull, for Black hamburgh, PMIII and grit, for catawaba sand and sawdust, for MKM-7, grit, sawdust and PMIII, for Regina in sand and Queen golden in PMIII.

Interaction between media and varieties for the 3 weeks callus trial (Table 4.5d) revealed that all the three potting mixtures resulted in the same shoot girth at the

apex bud for different varieties. When the same variety was considered in different media, the hybrid Anab x American seedling and varieties black hamburgh, catawaba and Queen golden showed differential response. A higher shoot girth at the apex bud was recorded when same variety was studied in different media: In case of Anab x American - sawdust, sand, grit, rice-hull, for Black hamburgh - sand, rice-hull, grit and PMII, for catawaba, grit, sand, sawdust and rice-hull and in case of Queen golden - sand and rice-hull.

The interaction for the 6 weeks callus experiment (Table 4.5e) revealed differential response in grit and the 3 potting mixtures. When the varieties were studied in respect to media, Anab x American and Black hamburgh displayed differential responses. The higher shoot girth at the apex bud was recorded by Black hamburgh in PMI, followed by Anab x American seedling in PMIII, II and grit in that order of non significant group.

4.6 Basal shoot girth:

The effect of rooting media and varieties on basal shoot girth (cm/plt) at 0, 3 and 6 weeks after callusing is shown in table 4.6a and the corresponding analysis of variance (ANOVA), given in table 4.6b.

Statistical analysis of data on rooting media revealed that mean basal shoot gith was highly significant for fresh and 3 weeks callus period. In trial with fresh cutting,

Table 4.6a: Basal shoot girth (cm) as affected by rooting medium and variety in grapes during the 1992 dry season

Treatments	Uncallused cutting	callused period (wks) 3	6
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	1.67bc	1.06d	1.34
Soil: FYM: Sand (25% 25% 50%)	1.09c	1.30cd	1.36
Soil: FYM: Sand (12.5% 12.5% 75%)	2.80a	1.23cd	1.30
Sand (100%)	2.32ab	1.58a-c	1.13
Grit (100%)	1.85bc	1.68ab	1.21
Rice-hull (100%)	1.64bc	1.77a	1.00
Sawdust (100%)	2.33ab	1.39b-d	1.00
SE ±	0.25	0.12	0.10
Significance	**	**	NS
Varieties:			
Anab-e-Shahi	1.85cd	1.00e	1.10bc
Anab x Amer	3.81a	2.46a	1.81a
Bangalore blue	1.91cd	1.32de	1.07bc
Black hamburgh	2.81b	1.92b	1.24bc
Cardinal	1.42de	1.00e	1.00c
Catawaba	1.88cd	1.81bc	1.26bc
Ex-Zaria Black	1.14e	1.01e	1.10bc
MKM-7	2.20bc	1.74bc	1.42b
Regina	1.38de	1.00e	1.12bc
Thompson Seedless	1.00e	1.00e	1.00c
Queen golden	2.16bc	1.49cd	1.00c
SE ±	0.23	0.14	0.12
Significance	**	**	**
Interaction:			
Rooting media x Variety			
Significance	**	**	NS

Means followed by the same letter(s) within a treatment group for particular character are not significant statistically at 5 perce probability. * and ** = significant at 5 and 1 percent leve respectively NS = not significant.

Table 4.6b Analysis of variance for basal shoot grit (cm) at 3 callusing periods

		Uncallused cuttings		Callused period (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	2.259	1.02	0.414	0.47	0.769	1.35
R.media	6	21.122	5.21	4.368	4.42	1.520	2.26
Error (a)	30	4.048	1.83	0.987	1.12	0.672	1.18
Varieties (V)	10	27.191	12.30	10.411	11.83	2.466	4.33
Int. M x V	60	5.271	2.38	0.965	1.09	0.508	0.89
Error (b)	350	2.209		0.880		0.569	

Table 4.6c: Basal shoot girth (cm) for fresh cutting as affec by the interaction of rooting medium and variety grapes during the 1992 dry season.

Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	S/Dst.	R/Hull	Percent Composition of: T/Soil / F.Y.M. / Sand	37.5 / 37.5 / 25.0	25.0 / 25.0 / 50.0	12.5 / 12.5 / 75.0
1. Anab-e-Shahi	1.33g-i	2.67d-i	1.50g-i	1.00i		2.17f-i	2.00f-i	2.25e-i
2. Anab x Amer Sed.	3.33c-h	5.67ab	4.67a-d	2.33e-i		2.83c-i	1.00i	6.83a
3. Bang. Blue	2.50d-i	1.17hi	2.50d-i	1.17i		2.33e-i	1.00i	2.67d-i
4. Bl. Hambourg	3.00c-i	4.08b-f	3.58b-g	2.22e-i		1.67g-i	1.00i	4.08b-f
5. Cardinal	1.25hi	1.00i	1.00i	1.00i		2.17f-i	1.00i	2.50d-i
6. Catawaba	1.67g-i	2.88c-i	2.92c-i	2.50d-i		1.17hi	1.00	1.00i
7. Ex-Zaria Bl.	1.33g-i	1.42g-i	1.17hi	1.00i		1.08hi	1.00i	1.00i
8. MKM-7	2.58d-i	1.00i	4.50b-e	2.00f-i		1.00i	1.00i	3.33c-h
9. Regina	1.00i	3.33c-h	1.33g-i	1.00i		1.00i	1.00i	1.00i
10. Thm. Seedless	1.00i	1.00i	1.00i	1.00i		1.00i	1.00i	1.00i
11. Queen golden	1.33g-i	1.33g-i	1.50g-i	2.83c-i		2.00f-i	1.00i	5.08a-c

Interaction $SE\pm$ 0.63

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

PMIII produced higher basal shoot girth than other media except sawdust and sand in experiment with 3 weeks callus cuttings, rice-hull produce higher basal shoot girth than other propagating media under trial except grit and sand.

When the varieties were critically observed, the differences were highly significant at all the periods of callusing. The hybrid Anab x American gave thicker basal shoot girth than all other varieties tested in the three callusing periods.

Interaction between rooting media and varieties was highly significant for fresh and 3 weeks callus experiments. When the interaction at 0 callusing was objectively examined (Table 4.6c), there was no significant difference among all the varieties for the basal shoot girth in PMI, II and rice-hull. When the same variety was studied in different propagating media, there was differential responses for Anab x American seedling, Black hamburgh, MKM-7, Regina and Queen golden. The highest basal shoot girth was found in Anab x American hybrid propagated in PMIII, followed by the same variety in sand, Queen golden in PMIII and Anab x American hybrid in sawdust which constituted a non significant group.

The interaction between rooting media and varieties in the 3 weeks callus experiment (Table 4.6d) showed that the three potting mixtures (I-III) have not resulted in differential response for different varieties in respect of

Table 4.6d: Basal shoot girth (cm) for 3 weeks callused cutting as affected by the interaction of rooting medium and variety in grapes during the 1992 dry season

	Main Tr.	100 percent of					Percent Composition of		
	Sub. Tr.	Grit	Sand	S/Dst.	R/Hull	T/Soil F.Y.M. Sand	37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0
1.	Anab-e-Shahi	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
2.	Anab x Amer Sed.	3.25a	3.33a	2.83a-c	3.00ab		1.00e	2.33b-e	1.50c-e
3.	Bang. Blue	1.75b-e	1.00e	1.25de	1.33de		1.00e	1.50c-e	1.42c-e
4.	Bl. Hambourg	2.25a-e	2.58a-d	1.00e	2.25a-e		1.50c-e	1.83b-e	2.00a-e
5.	Cardinal	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
6.	Catawaba	2.50a-d	1.92a-e	2.00a-e	2.42a-d		1.20de	1.50c-e	1.17de
7.	Ex-Zaria Bl.	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
8.	MKM-7	2.00a-e	2.33a-e	1.83b-e	2.50a-d		1.00e	1.08e	1.42c-e
9.	Regina	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
10.	Thm. Seedless	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
11.	Queen golden	1.75b-e	1.25de	1.42c-e	3.00ab		1.00e	1.00e	1.00e

Interaction SE± 0.39

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

basal shoot girth production, likewise when the same variety was considered in different media, except for the varieties cardianal and Regina, all other varieties exhibited a differential response. A non significant group of higher basal shoot girth was found in the hybrid Anab x American seedling in sand, grit, rice-hull and sawdust. For Black hamburgh, sand, grit rice-hull and PMIII, for MKM-7, in rice-hull, sand and grit and for Queen golden rice-hull.

4.7 Shoot fresh weight

The effect of rooting media and varieties on shoot fresh weight (g/plt) at 0, 3 and 6 weeks after callusing is given in table 4.7a and the corresponding analysis of variance is shown in table 4.7b.

Analysis of data on propagating media revealed that mean shoot fresh weight was significant at 5% level only for the 3 weeks callus trial. Rice-hull gave significantly heavier fresh shoot than all other media under trial except grit and sand.

When the varieties were studied closely, it was found that the differences were highly significant for all the three periods of callusing. In trials with fresh cuttings, the varieties Black hamburgh gave significantly higher fresh shoot weight than all other varieties tested. This was followed by Catawaba, Cardinal, Thompson seedless, MKM-7,

Table 4.7a: Shoot fresh weight (g) as influenced by rooting medium and variety in grapes during the 1992 dry season.

Treatments	Uncallused Cutting	Callus periods(wks 3	
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	1.11	1.02c	1.02
Soil: FYM: Sand (25% 25% 50%)	1.10	1.06bc	1.03
Soil: FYM: Sand (12.5% 12.5% 75%	1.16	1.07bc	1.04
Sand (100%)	1.27	1.13ab	1.01
Grit (100%)	1.13	1.15ab	1.01
Rice-hull (100%)	1.35	1.17a	1.00
Sawdust (100%)	1.31	1.07bc	1.00
SE ±	0.08	0.03	1.01
Significance	NS	*	NS
Varieties:			
Anab-e-Shahi	1.01d	1.00d	1.01b
Anab x Amer	1.20b-d	1.31a	1.07a
Bangl. Blue	1.17b-d	1.07c-d	1.00b
Blk Hamb.	1.62a	1.20ab	1.02b
Cardinal	1.28bc	1.00d	1.00b
Catawaba	1.32b	1.18b	1.02b
Ex-Zaria Blk	1.06cd	1.01d	1.01b
MKM-7	1.20b-d	1.13bc	1.05a
Regina	1.03cd	1.00d	1.00b
Thomp. Sdl.	1.28bc	1.00d	1.00b
Queen Gol.	1.07cd	1.16bc	1.00b
SE ±	0.08	0.03	0.01
Significance	**	**	**
Interaction:			
Rooting media x Variety			
Significance	**	**	**

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability. * and ** = significant at 5 and 1 percent levels respectively NS = not significant.

Table 4.7b Analysis of variance for shoot fresh weight (g) at the 3 callusing periods

		Uncallused cutting		Callus periods (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	0.211	0.81	0.066	1.49	0.006	1.17
R.media	6	0.712	1.78	0.211	3.29	0.014	2.19
Error (a)	30	0.400	1.51	0.64	1.45	0.006	1.22
Varieties (V)	10	1.29	14.94	0.470	10.63	0.023	4.40
Int. M x V	60	0.367	1.41	0.061	1.37	0.006	1.11
Error (b)	350	0.260		0.044		0.005	

Table 4.7c: Shoot fresh weight (g) for fresh cutting as affected by the interaction of rooting medium and variety in grapes during the 1992 dry season.

		100 percent of					Percent Composition of		
	Main Tr.	Grit	Sand	S/Dst.	R/Hull	T/Soil	37.5	25.0	12.5
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5
						Sand	25.0	50.0	75.0
1.	Anab-e-Shahi	1.09d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
2.	Anab x Amer Sed.	1.09d	1.53b-d	1.41b-d	1.00d		1.39b-d	1.00d	1.00d
3.	Bang. Blue	1.03d	1.37b-d	1.08d	1.00d		1.18cd	1.36b-d	1.19cd
4.	Bl. Hambourg	1.17cd	1.61b-d	1.86bc	2.83a		1.26cd	1.33b-d	1.26cd
5.	Cardinal	1.34b-d	1.21cd	1.61b-d	1.19cd		1.00d	1.25cd	1.36b-d
6.	Catawaba	1.38b-d	1.69b-d	1.61b-d	1.25cd		1.00d	1.00d	1.28b-d
7.	Ex-Zaria Bl.	1.03d	1.00d	1.00d	1.00d		1.25cd	1.00d	1.10cd
8.	MKM-7	1.08d	1.36b-d	1.19cd	1.52b-d		1.12cd	1.00d	1.12cd
9.	Regina	1.00d	1.06d	1.03d	1.00d		1.00d	1.00d	1.09d
10.	Thm. Seedless	1.16cd	1.00d	1.61b-d	2.03b		1.00d	1.00d	1.15cd
11.	Queen Golden	1.04d	1.10cd	1.03d	1.00d		1.00d	1.10cd	1.18cd

Interaction SE± 0.21

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.7d: Shoot fresh weight (cm) for 3 weeks callused cutting as affected by the interaction of rooting medium and variety in grapes during the 1992 dry season.

	Main Tr. / Sub. Tr.	100 percent of Grit	Sand	S/Dst.	R/Hull	T/Soil F.Y.M. Sand	Percent Composition of 37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0
1.	Anab-e-Shahi	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
2.	Anab x Amer Sed.	1.53ab	1.57a	1.36a-d	1.30a-e		1.00e	1.16c-e	1.25a-e
3.	Bang. Blue	1.20c-e	1.00e	1.03e	1.12c-e		1.00e	1.06de	1.09c-e
4.	Bl. Hambourg	1.21b-e	1.30a-e	1.00e	1.32a-e		1.16c-e	1.16c-e	1.25a-e
5.	Cardinal	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
6.	Catawaba	1.41a-c	1.21b-e	1.12c-e	1.29a-e		1.05de	1.07de	1.07de
7.	Ex-Zaria Bl.	1.00e	1.00e	1.00e	1.00e		1.00e	1.09c-e	1.00e
8.	MKM-7	1.22b-e	1.18c-e	1.12c-e	1.12c-e		1.00e	1.10c-e	1.06de
9.	Regina	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
10.	Thm. Seedless	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
11.	Queen Golden	1.10c-e	1.20c-e	1.14c-e	1.14c-e		1.00e	1.00e	1.00e

Interaction SE± 0.09

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.7e: Shoot fresh weight (g) for 6 weeks callused experiment as influenced by the interaction of rooting medium and variety during the 1992 dry season.

		100 percent of					Percent Composition of		
	Main Tr.	Grit	Sand	S/Dst.	R/Hull	T/Soil	37.5	25.0	12.5
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5
						Sand	25.0	50.0	75.0
1.	Anab-e-Shahi	1.05cd	1.00d	1.00d	1.00d		1.00d	1.00d	1.00e
2.	Anab x Amer Sed.	1.05cd	1.04cd	1.00d	1.00d		1.11a-b	1.08cd	1.20a
3.	Bang. Blue	1.00d	1.00d	1.00d	1.00d		1.00d	1.01cd	1.01cd
4.	Bl. Hambourg	1.00d	1.02cd	1.00d	1.00d		1.03cd	1.08cd	1.00d
5.	Cardinal	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
6.	Catawaba	1.00d	1.01cd	1.00d	1.00d		1.09b-d	1.02cd	1.00d
7.	Ex-Zaria Bl.	1.00d	1.00d	1.00d	1.00d		1.00d	1.01cd	1.02cd
8.	MKM-7	1.00d	1.03cd	1.00d	1.00d		1.04cd	1.11a-c	1.19ab
9.	Regina	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
10.	Thm. Seedless	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
11.	Queen Golden	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d

Interaction SE± 0.030

Means followed by the same letter(s) within a treatment group for a particular character *are not significant statistically at 5 percent probability.*

Anab x American hybrid and Bangalore blue which fall into a non-significant group. However, fresh shoot weight of Catawaba was significantly higher than those of Queen golden, Ex-Zaria-black, Regina and Anab-e-shahi. At 3 weeks callus period, Anab x American hybrid produced higher fresh shoot weight than all other varieties except Black hamburgh which was significantly at par with Catawaba, Queen golden and MKM-7, and significantly higher than the rest of the varieties tested. While in experiment with 6 weeks callus cuttings, Anab x American hybrid and MKM-7 yielded higher shoot fresh weight than all other varieties on trial which constituted a second non significant group.

The interaction between rooting media and varieties was highly significant for the three callusing periods. When the interaction at 0 callusing (Table 4.7c)was examined critically, it was observed that there was no significant difference among the varieties for fesh shoot weight in the three potting mixtures (I-III), sand and grit. Studying the same variety in different media, it was observed that the varieties Black hamburgh and Thompson seedless exhibited differential responses in the different media tested. The heaviest shoot fresh weight was recorded for Black hamburgh in rice-hull, this was followed by Thompson seedless in the same medium.

A close study of the interaction for the 3 weeks callus experiment (Table 4.7d) revealed no statistical difference among the varieties for fresh shoot weight in the three potting mixtures and rice-hull when the variety were considered in the different propagation media, Anab x American and Catawaba exhibited significant differential response in the media tested. Heavier shoot fresh weight was produced by Anab x American seedlings in sand. This was found to be statiscally same as that produced by Black hamburgh in sand, Anab x American hybrid and Catawaba in grit, Black hamburgh, Anab x American and Catawaba in rice-hull, Anab x American and Black hamburgh in PMIII and Anab x American seedling in sawdust in that order.

In experiment with 6 weeks callus cuttings (Table 4.7e), when the same rooting media was used to evaluate different varieties, differential response was observed in all the three potting mixtures, and when the same variety was examined in different rooting media, Anab x American and MKM-7 were found to give differential response. The highest shoot fresh weight was recorded for Anab x American in PMIII which was statistically same as MKM-7 in the same mixture, followed by the same variety in PMII and Anab x American hybrid in PMI.

4.8 Shoot Volume

The shoot volume (ml/plt) as affected by rooting media and varieties at 0, 3 and 6 weeks after callusing is shown in table 4.8a and the corresponding analysis of variance is given in table 4.8b.

Statistical analysis of data on rooting media showed that mean shoot volume was highly significant only for fresh cuttings, the 3 and 6 weeks callused trials were not significant.

Potting mixture III, 100% sand and sawdust produced significantly higher shoot volume than other media tested, except grit and rice-hull. When the varieties were considered, the three callusing periods were found to be highly significant. The hybrid Anab x American seedling produced highest shoot volume in all the three experiments. In trial with fresh cuttings, it was significantly higher than all other treatments, followed by Queen golden and Black hamburgh. In 3 weeks callused trial, the hybrid Anab x American seedling was statistically at par with Black hamburgh and Catawaba whereas in the 6 weeks callused experiment it was at par with MKM-7.

The interaction between rooting media and varieties was found to be highly significant for all the periods of callusing. When the interaction at 0 period of callusing was critically examined, it was observed that there was no

Table 4.8a: Shoot volume (ml) as affected by rooting medium and variety in grapes during the 1992 dry season

Treatments	Uncallused cutting	Callus periods (wks) 3	6
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	1.67bc	1.03	1.24
Soil: FYM: Sand (25% 25% 50%	1.13c	1.13	1.31
Soil: FYM: Sand (12.5%12.5% 75%)	2.46a	1.15	1.30
Sand (100%)	1.94ab	1.35	1.10
Grit (100%)	1.60bc	1.33	1.23
Rice-hull (100%)	1.80b	1.40	1.00
Sawdust (100%)	2.11ab	1.20	1.08
SE ±	0.19	0.09	0.09
Significance	**	NS	NS
Varieties:			
Anab-e-Shahi	1.56cd	1.00d	1.12c
Anab x Amer	3.07a	1.69a	1.65a
Bangl. Blue	1.96bc	1.12cd	1.02c
Blk Hamb.	2.31b	1.49ab	1.17c
Cardinal	1.18d	1.00d	1.00c
Catawaba	2.05bc	1.52ab	1.30bc
Ex-Zaria Blk	1.19d	1.00d	1.08c
MKM-7	2.00bc	1.31bc	1.54ab
Regina	1.26d	1.00d	1.00c
Thomp. Sdl.	1.04d	1.00d	1.00c
Queen Gol.	2.35b	1.37b	1.05c
SE ±	0.20	0.08	0.10
Significance	**	**	**
Interaction:			
Rooting media x Variety			
Significance	**	**	**

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability. * and ** = significant at 5 and 1 percent levels respectively NS = not significant.

Table 4.8b Analysis of variance for shoot volume (ml) for the 3 periods of callusing

		Uncallused cutting		Callus periods (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	1.732	1.00	0.707	2.61	0.501	1.27
R.media	6	11.484	4.63	1.226	2.27	1.088	2.30
Error (a)	30	2.479	1.43	0.540	2.00	0.473	1.20
Varieties (V)	10	16.809	9.73	2.803	10.38	2.142	5.46
Int. M x V	60	2.803	1.62	0.508	1.88	0.402	1.02
Error (b)	350	1.727		0.270		0.392	

Table 4.8c: Shoot fresh weight (g) for fresh cutting as affected by interaction of rooting medium and variety in grapes during the 1992 dry season.

		100 percent of					Percent Composition of		
	Main Tr.	Grit	Sand	S/Dst.	R/Hull	T/Soil	37.5	25.0	12.5
	Sub. Tr.					P.Y.M.	37.5	25.0	12.5
						Sand	25.0	50.0	75.0
1.	Anab-e-Shahi	1.12i-k	1.83d-k	1.50f-k	1.00k		2.00d-k	1.69e-k	1.83d-k
2.	Anab x Amer Sed.	1.90d-k	4.33a-c	3.20b-k	3.08b-i		2.33d-k	1.17f-k	3.00b-i
3.	Bang. Blue	2.17d-k	1.83d-k	3.25b-g	1.12i-k		1.83d-k	1.50f-k	3.00b-i
4.	Bl. Hambourg	2.75b-k	2.30d-k	3.67a-d	1.92d-k		1.50f-k	1.00k	3.00b-i
5.	Cardinal	1.08jk	1.00k	1.00k	1.17i-k		2.00d-k	1.00k	1.00k
6.	Catawaba	1.42g-k	2.83b-k	2.53c-k	2.42c-k		1.33g-k	1.08jk	2.75b-k
7.	Ex-Zaria Bl.	1.33g-k	1.30g-k	1.17i-k	1.17i-k		1.50f-k	1.03jk	1.00d-k
8.	MKM-7	2.15d-k	1.53f-k	3.42b-k	1.92d-k		1.67e-k	1.00k	2.33d-k
9.	Regina	1.67e-k	1.50f-k	1.20h-k	1.45f-k		1.00k	1.00k	1.00k
10.	Thm. Seedless	1.00k	1.25h-25	1.00k	1.00k		1.00k	1.00k	1.00k
11.	Queen Golden	1.23h-k	1.67e-k	2.22d-k	3.58a-e		2.17d-17	1.00k	4.58ab

Interaction SE'_ 0.55

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.8d: Shoot fresh weight (g) for 3 weeks callused cutting as influenced by the interaction of rooting medium and variety in grapes during the 1992 dry season

	Main Tr.	100 percent of				Percent Composition of		
	Sub. Tr.	Grit	Sand	S/Dst.	R/Hull	T/Soil	37.5	25.0	12.5
						F.Y.M.	37.5	25.0	12.5
						Sand	25.0	50.0	75.0
1.	Anab-e-Shahi	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
2.	Anab x Amer Sed.	1.58a	2.25a-c	1.75b-e	1.58c-e		1.00e	1.17de	1.50de
3.	Bang. Blue	1.00e	1.00e	1.00e	1.42d-e		1.00e	1.08de	1.33de
4.	Bl. Hambourg	1.50c-e	1.83a-d	1.00e	1.67b-e		1.17de	1.58c-e	1.67b-e
5.	Cardinal	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
6.	Catawaba	2.42ab	1.25b-e	1.50c-e	1.58c-e		1.17de	1.25de	1.00e
7.	Ex-Zaria Bl.	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
8.	MKM-7	1.00e	1.50c-e	1.58c-e	1.58c-e		1.00e	1.33de	1.17de
9.	Regina	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
10.	Thm. Seedless	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
11.	Queen Golden	1.17de	1.50c-e	1.33de	2.58a		1.00e	1.00e	1.00e

Interaction SE' 0.22

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.8e: Shoot volume (ml) for 6 weeks callused cutting as affected by the interaction of rooting medium and variety in grapes during the 1992 dry season

	Main Tr.	100 percent of					Percent Composition of		
	Sub. Tr.	Grit	Sand	S/Dst.	R/Hull	T/Soil F.Y.M. Sand	37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0
1.	Anab-e-Shahi	1.83a-d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
2.	Anab x Amer Sed.	1.75a-d	1.25cd	1.00d	1.00d		2.08a-c	2.08a-c	2.37ab
3.	Bang. Blue	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.17cd
4.	Bl. Hambourg	1.00d	1.08d	1.00d	1.00d		1.25cd	1.83a-d	1.00d
5.	Cardinal	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
6.	Catawaba	1.42cd	1.30cd	1.00d	1.00d		1.93a-d	1.33cd	1.17cd
7.	Ex-Zaria Bl.	1.25cd	1.00d	1.17cd	1.00d		1.00d	1.17cd	1.00d
8.	NKM-7	1.30cd	1.50b-d	1.17cd	1.00d		1.50b-d	1.83a-d	2.45a
9.	Regina	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
10.	Thm. Seedless	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
11.	Queen Golden	1.00d	1.00d	1.00d	1.00d		1.00d	1.17cd	1.17cd

Interaction SE± 0.26

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

significant difference among the varieties for shoot volume in potting mixtures I, II and grit. When the different rooting media was considered at same varietal level, the highest shoot volumes group of significance consisted of Anab x American seedling in potting mixture III which was significantly at par with the same variety in sand, Black hamburgh in sawdust, and Queen golden in rice-hull and potting mixture III.

Interaction between media and varieties in the 3 weeks callused experiment (Table 4.8d) revealed that there was no significant difference among varieties for shoot volume in all the three potting mixtures, and sawdust. When the varieties were considered in different rooting media, Anab x American hybrid and the varieties Black hamburgh and Queen golden exhibited differential responses. The highest shoot volume significant group consist of Anab x American seedling in grit and sand, Queen golden in rice-hull, Black hamburgh in sand and Catawaba in grit.

In the 6 weeks callused trial (Table 4.8e), there was no statistical difference among varieties for shoot volume in all the media tested except in the three potting mixtures. When the different media were compared at the same varietal level, the hybrid Anab x American seedling and MKM-7 responded differentially to rooting media. The highest shoot volume significant group consisted of Anab-e-shahi in grit and the three potting mixtures. Black hamburgh in PMII, Catawaba in PMI and MKM-7 in PMII and III.

4.9 Shoot dry weight

The shoot dry weight (g/plt) as affected by rooting media and varieties at 0, 3 and 6 weks after callusing is shown in table 4.9a and the corresponding analysis of variance is given in table 4.9b.

Statistical analysis of data on rooting media revealed that mean shoot dry weight was highly significant only for the 3 weeks callus experiment. For the 3 weeks callus trial, rice-hull produced significantly heavier dry shoots than all other media tested which constituted a non significant group.

When the varieties were considered, the differences were highly significant for the three periods of callusing. The hybrid Anab x American produced significant heavier dry shoot than all other varieties under trial in the three experiments, however in the trial with 6 weeks callus cuttings, shoot dry weight of the hybrid Anab x American seedling was at par with that of MKM-7.

Interaction between rooting media and varieties was found to be highly significant for fresh and 3 weeks callus trial (Table 4.9d and 4.9e). When the interaction at 0 callusing was critically examined, it was noted that there was differential response of the same rooting media when studied with different varieties in sand and PMJ and III. Similarly the hybrid Anab x American and Queen golden exhibited a differential response in different rooting media. The highest shoot dry weight was recorded for

Table 4.9a: Shoot dry (g) as affected by rooting medium and variety in grapes during the 1992 dry season

Treatments	Uncallused Cutting	Callus periods(wks 3	6
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	1.06	1.01b	1.02
Soil: FYM: Sand (125% 25% 50%)	1.02	1.01b	1.02
Soil: FYM: Sand (12.5% 12.5% 75%)	1.13	1.01b	1.02
Sand (100%)	1.11	1.02b	1.00
Grit (100%)	1.05	1.03b	1.01
Rice-hull (100%)	1.09	1.10a	1.00
Sawdust (100%)	1.11	1.03b	1.00
SE±	0.03	0.01	0.01
Significance	NS	**	NS
Varieties:			
Anab-e-Shahi	1.06bc	1.00d	1.01b
Anab x Amer	1.21a	1.10a	1.03a
Bangl. Blue	1.11b	1.01d	1.00b
Blk Hamb.	1.12b	1.04c	1.01b
Cardinal	1.01c	1.00d	1.00b
Catawaba	1.11b	1.07b	1.01b
Ex-Zaria Blk	1.01c	1.00d	1.00b
MKM-7	1.10b	1.04c	1.03a
Regina	1.00c	1.00d	1.00b
Thomp. Sdl.	1.00c	1.00d	1.00b
Queen Gol.	1.12b	1.06bc	1.00b
SE ±	0.03	0.01	0.007
Significance	**	**	**
Interaction:			
Rooting media x Variety			
Significance	**	**	NS

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability. * and ** = significant at 5 and 1 percent levels respectively NS = not significant.

Table 4.9b Analysis of variance for shoot dry weight (g) for the 3 callusing periods

		Uncallused cutting		Callus periods (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	0.010	0.27	0.005	0.70	0.002	1.09
R.media	6	0.106	1.88	0.064	5.93	0.004	1.52
Error (a)	30	0.0565	1.58	0.011	1.45	0.002	1.25
Varieties (V)	10	0.171	4.79	0.051	6.88	0.006	3.25
Int. M x V	60	0.040	1.12	0.017	2.30	0.002	0.92
Error (b)	350	0.036		0.007		0.002	

Table 4.9c: Shoot dry (g) for fresh cuttings as affected by rooting medium and variety in grapes during the 1992 dry season.

	Main Tr.	100 percent of					Percent Composition of		
	Sub. Tr.	Grit	Sand	S/Dst.	R/Hull	T/Soil F.Y.M. Sand	37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0
1.	Anab-e-Shahi	1.03cd	1.10cd	1.04cd	1.00d		1.11cd	1.08cd	1.08cd
2.	Anab x Amer Sed.	1.16b-d	1.40ab	1.27b-d	1.26b-d		1.67a	1.04cd	1.28b-d
3.	Bang. Blue	1.10cd	1.07cd	1.27b-d	1.03cd		1.09cd	1.04cd	1.09cd
4.	Bl. Hambourg	1.16b-d	1.20b-d	1.17b-d	1.06cd		1.07cd	1.00d	1.20b-d
5.	Cardinal	1.02d	1.00d	1.00d	1.00d		1.09cd	1.00d	1.00d
6.	Catawaba	1.03cd	1.17b-d	1.13b-d	1.27b-d		1.02d	1.00d	1.18b-d
7.	Ex-Zaria Bl.	1.01d	1.03cd	1.02d	1.00d		1.04cd	1.00d	1.00d
8.	MKM-7	1.08cd	1.00d	1.22b-d	1.31b-d		1.00d	1.03cd	1.08cd
9.	Regina	1.00d	1.21b-d	1.02d	1.00d		1.00d	1.00d	1.00d
10.	Thm. Seedless	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
11.	Queen Golden	1.00d	1.04cd	1.01d	1.09b-d		1.15b-d	1.00d	1.42ab

Interaction SE± 0.08

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.9d: Shoot dry weight (g) for 3 weeks callused trial as affected rooting medium and variety in grapes during the 1992 dry season

	Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	S/Dst.	R/Hull	T/Soil : P.Y.M. : Sand	Percent Composition of: 37.5 : 37.5 : 25.0	25.0 : 25.0 : 50.0	12.5 : 12.5 : 75.0
1.	Anab-e-Shahi	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
2.	Anab x Amer Sed.	1.13c-e	1.11de	1.25a-c	1.10de		1.00e	1.01e	1.07de
3.	Bang. Blue	1.03e	1.00e	1.00e	1.02e		1.00e	1.00e	1.00e
4.	Bl. Hambourg	1.03e	1.04e	1.00e	1.11de		1.07de	1.02e	1.05de
5.	Cardinal	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
6.	Catawaba	1.00de	1.04e	1.08de	1.30ab		1.01e	1.01e	1.00e
7.	Ex-Zaria Bl.	1.00e	1.00e	1.00e	1.00e		1.00e	1.01e	1.01e
8.	MKM-7	1.04e	1.03e	1.01e	1.18b-d		1.00e	1.01e	1.00
9.	Regina	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
10.	Thm. Seedless	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e
11.	Queen Golden	1.05de	1.03e	1.00e	1.34a		1.00e	1.00e	1.00e

Interaction SE± 0.04

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Anab x American seedling in PMI which was statistically at par with Queen golden in PMIII and Anab x American hybrid in sand.

Interaction in the 3 weeks callus expeiment, when critically examined, showed there was differential response in sand and rice-hull for the different varieties when the varieties were considered in different media, the hybrid Anab x American and the varieties Catawaba, MKM-7 and Queen golden showed differential responses in dry shoot weight production due to rooting media. Higher dry shoot weight were recorded for Queen golden in rice-hull, followed by Catawaba in the same medium and Anab x American hybrid in sawdust which constituted a non significant group.

4.10 Number of Roots

The effect of rooting media and varieties on number of roots per plant at 0, 3 and 6 weeks after callusing is given in table 4.10a and the corresponding analysis of variance (ANOVA) shown in table 4.10b.

The analysis of data on rooting media revealed that mean number of roots was highly significant for the fresh cuttings, and significant at 5% level for the 6 weeks callused experiments. In trial with fresh cuttings, PMIII, grit, sand and sawdust produced statistically the same number of roots and which were significantly higher than PMII. In 6 weeks callused trial, the three potting

Table 4.10a: Number of roots produced per cutting as affected by rooting medium and variety in grapes during the 1992 dry season

Treatments	Uncallused Cutting	Callus periods(wks 3	6
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	3.68bc	1.74	2.89a
Soil: FYM: Sand (25% 25% 50%)	2.53c	1.97	2.82a
Soil: FYM: Sand (12.5% 12.5% 75%)	7.50a	2.79	2.71a
Sand (100%)	5.73ab	4.09	1.92ab
Grit (100%)	5.79ab	3.29	2.74a
Rice-hull (100%)	3.62bc	2.62	1.00b
Sawdust (100%)	7.14a	2.08	1.00b
SE ±	1.01	0.72	0.46
Significance	**	NS	*
Varieties:			
Anab-e-Shahi	3.74c-e	1.48c	1.31c
Anab x Amer	13.26a	5.74a	5.40a
Bangl. Blue	6.12c	2.62bc	1.43c
Blk Hamb.	9.19b	4.40ab	2.98bc
Cardinal	2.64de	1.71c	1.00c
Catawaba	4.62cd	3.69bc	2.62bc
Ex-Zaria Blk	2.29de	1.00c	1.38c
MKM-7	6.17c	3.79bc	4.05ab
Regina	2.74de	1.00c	1.55c
Thomp. Sdl.	1.02e	1.21c	1.00c
Queen Gol.	4.76cd	2.55bc	1.00c
SE ±	0.99	0.65	0.65
Significance	**	**	**
Interaction:			
Rooting media x Variety			
Significance	**	**	NS

*Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability. * and ** = significant at 5 and 1 percent levels respectively NS = not significant.*

Table 4.10b Analysis of variance for number of roots produced per cutting at the 3 callusing periods.

		Uncallused cutting		Callus periods (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	21.00	0.51	53.28	3.04	12.68	0.71
R.media	6	237.20	3.49	45.31	1.33	47.99	3.37
Error (a)	30	67.78	1.64	33.96	1.93	14.22	0.80
Varieties (V)	10	520.21	12.65	103.99	5.93	89.23	5.06
Int. M x V	60	62.84	1.52	19.17	1.09	15.62	0.88
Error (b)	350	41.12		17.51		17.63	

Table 4.10c: Number of roots produced per cutting for fresh cuttings as affected by interaction of rooting medium and variety in grapes during the 1992 dry season.

		100 percent of				Percent Composition of		
	Main Tr.	Grit	Sand	S/Dst.	R/Hull	T/Soil	37.5	25.0	12.5
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5
						Sand	25.0	50.0	75.0
1.	Anab-e-Shahi	3.33e-h	6.17d-h	3.83e-h	1.00h		5.67d-h	2.00gh	4.17e-h
2.	Anab x Amer Sed.	16.67ab	16.17a-c	18.50a	11.50a-g		6.83c-h	6.67c-h	16.67ab
3.	Bang. Blue	10.67a-h	1.83g	5.00e-h	2.50f-h		7.00b-h	7.17b-h	8.67b-h
4.	Bl. Hambourg	11.83a-f	13.00a-e	16.67ab	3.17f-h		4.83e-h	1.00h	13.00a-e
5.	Cardinal	5.50d-h	3.83e-h	1.00h	2.67f-h		2.33f-h	1.00h	2.17f-h
6.	Catawaba	1.50h	7.33b-h	8.50b-h	3.50e-h		3.83e-h	1.00h	6.67c-h
7.	Ex-Zaria Bl.	2.50f-h	3.67e-h	1.67h	2.67g-h		2.00gh	1.00h	2.50f-h
8.	MKM-7	6.50c-h	2.17f-h	16.67ab	5.00e-h		1.00g	1.83h	10.00a-h
9.	Regina	3.17f-h	5.83d-h	1.83g	1.00h		1.17g	4.00e-h	2.17f-h
10.	Thm. Seedless	1.00h	1.00h	1.00h	1.00h		1.00g	1.17h	1.00h
11.	Queen Golden	1.00h	2.00g	3.83e-h	5.83d-h		4.83e-h	1.00h	14.83a-d

Interaction SE± 2.70

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.10d: Number of roots produced per cutting for the 3 weeks callused cutting as affected rooting medium and variety in grapes during the 1992 dry season

		100 percent of					Percent Composition of		
	Main Tr.	Grit	Sand	S/Dst.	R/Hull	T/Soil	37.5	25.0	12.5
	Sub. Tr.					P.Y.M.	37.5	25.0	12.5
						Sand	25.0	50.0	75.0
1.	Anab-e-Shahi	2.33d-f	1.00f	1.00f	3.00b-f		1.00f	1.00f	1.00f
2.	Anab x Amer Sed.	8.00a-d	11.33a	3.33b-f	3.00b-f		5.17a-f	3.00b-f	6.33a-f
3.	Bang. Blue	4.67b-f	2.33d-f	1.00f	2.67d-f		3.83b-f	1.00f	2.83c-f
4.	Bl. Hambourg	1.17f	9.33ab	1.50ef	3.83b-f		1.00f	4.83b-f	9.17a-c
5.	Cardinal	4.17b-f	1.00f	1.00f	2.17d-f		2.17d-f	1.00f	1.67d-f
6.	Catawaba	7.67a-e	6.33a-f	3.17b-f	3.00b-f		1.00f	2.00d-f	1.50ef
7.	Ex-Zaria Bl.	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f
8.	MKM-7	1.00f	6.67a-f	5.67a-f	3.17b-f		1.00f	4.83b-f	4.17b-f
9.	Regina	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f
10.	Thm. Seedless	1.00f	1.00f	1.00f	2.50d-f		1.00f	1.00f	1.00f
11.	Queen Golden	4.17b-f	4.00b-f	3.17b-f	3.50b-f		1.00f	1.00f	1.00f

Interaction SE± 1.78

Means followed by the same letter(s) within a treatment group for a particular character *are not significant statistically at 5 percent probability.*

mixtures (I-III), grit and sand produced more roots than rice-hull and sawdust except sand which was statistically at par with rice-hull and sawdust.

When the varieties were critically examined, it was observed that all the three periods of callusing produced significant responses. In trials with fresh cuttings, the hybrid Anab x American seedling produced more roots in all the three experiments. In trial with fresh cuttings, it was followed by Black hamburgh but in the 3 weeks callused cuttings, root number of Anab x American was significantly at par with Black hamburgh and MKM-7 respectively.

The interaction between rooting media and varieties was found to be highly significant for the fresh and 3 weeks callused trials (Table 4.10c and 4.10d). When the interaction for the fresh cutting trial was critically observed, there was no significant difference among the eleven varieties tested for the number of roots per plant in PMI and II. When same variety was considered in relation to different propagating media, it was observed that Anab x American hybrid produced more roots in all the rooting media except PMI and II. This root number was statistically at par with those of Black hamburgh in grit, sand, sawdust and PMIII. In addition root number was statistically same for Bangalore blue in grit, MKM-7 in sawdust and PMIII, also the variety Queen golden produced statistically same number of roots in PMIII. When same variety was studied in different

media, the varieties Anab-shahi, cardinal, Catawaba and Ex-Zaria black did not show any differential response to different rooting media for prolific root production.

Interaction between rooting media and varieties in the 3 weeks callused experiment showed no differential response in sawdust, rice-hull, PMI and II when the same rooting media was compare for different varieties for number of roots production, but when the same variety was considered in different media, the hybrid Anab x American seedling produced statistically higher number of roots which were statistically at par in grit, sand, PMI and III. This constituted a non significant group with Catawaba in grit and sand, with Black hamburgh in sand and PMIII.

4.11 Root Length

The effect of rooting media and varieties on root length (cm/plt) at 0, 3 and 6 weeks after callusing is given in table 4.11a and the corresponding analysis of variance is shown in table 4.11b.

Analysis of the data on rooting media showed that mean root length was significant at 5% level only for the 6 weeks callused trial. The 0 and 3 weeks callused experiment gave no significant response to root length production.

Table 4.11a: Root length (cm) as affected by rooting medium and variety in grapes during the 1992 dry season

Treatments	Uncallused Cutting	Callus periods(wks 3	
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	59.1	7.0	22.0a
Soil: FYM: Sand (25% 25% 50%)	5.9	22.1a	
Soil: FYM: Sand (12.5% 12.5% 75%)	97.1	23.0	18.4a
Sand (100%)	58.1	30.4	10.6ab
Grit (100%)	50.8	20.5	10.4ab
Rice-hull (100%)	45.2	22.2	1.0b
Sawdust (100%)	83.5	13.0	1.0b
SE ±	16.80	6.07	5.35
Significance	NS	NS	*
Varieties:			
Anab-e-Shahi	191.8a	2.3d	2.5bc
Anab x Amer	81.2c	51.3a	46.8a
Bangl. Blue	132.8b	12.1cd	4.3bc
Blk Hamb.	25.8c-e	41.2ab	25.7b
Cardinal	45.0c-e	2.4d	1.0c
Catawaba	12.4e	31.5a-c	15.0bc
Ex-Zaria Blk	71.4cd	2.4d	3.5bc
MKM-7	18.8de	23.8b-d	24.7b
Regina	1.3e	8.6cd	8.7bc
Thomp. Sdl.	50.0c-e	3.3d	1.0c
Queen Gol.	28.2c-e	12.6cd	1.0c
SE ±	17.64	7.54	7.32
Significance	**	**	**
Interaction:			
Rooting media x Variety			
Significance	**	NS	NS

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability. * and ** = significant at 5 and 1 percent levels respectively NS = not significant.

Table 4.11b Analysis of variance for root length (cm) at the 3 callusing periods

		Uncallused cutting		Callus periods (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	5137	0.39	2321	0.97	1282	0.57
R.media	6	37759	2.02	5438	2.23	5367	2.84
Error (a)	30	18611	1.42	2431	1.01	1885	0.83
Varieties (V)	10	139330	10.66	12420	5.70	9105	4.04
Int. M x V	60	15322	1.17	2081	0.87	1977	0.87
Error (b)	350	13068		2388		2252	

Table 4.11c: Root length (cm) for fresh cutting as influenced by interaction of rooting medium and variety in grapes during the 1992 dry season.

	Main Tr. / Sub. Tr.	100 percent of				Percent Composition of			
		Grit	Sand	S/Dst.	R/Hull	T/Soil F.Y.M. Sand	37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0
1.	Anab-e-Shahi	185.30a-g	237.70a-d	216.00a-f	157.30a-h		160.50a-h	26.30gh	265.70ab
2.	Anab x Amer Sed.	88.90c-h	60.20d-h	59.90e-h	15.00gh		135.82a-h	35.50gh	167.00a-h
3.	Bang. Blue	168.90a-h	123.50a-h	226.80a-e	31.30gh		89.20e-h	1.00h	288.00a
4.	Bl. Hambourg	35.000gh	21.50gh	1.00h	1.00h		115.80a-g	1.00h	5.00h
5.	Cardinal	2.00h	64.50e-h	108.10b-h	43.00f-h		17.00gh	1.00h	78.80c-h
6.	Catawaba	10.90h	22.60gh	6.30h	25.30gh		14.30gh	1.00h	6.70h
7.	Ex-Zaria Bl.	55.00e-h	6.70h	251.10a-c	85.00c-h		16.00gh	13.50gh	72.30d-h
8.	MKM-7	9.70h	63.90e-h	9.30h	1.00h		3.80h	36.50gh	6.70h
9.	Regina	1.00h	1.00h	1.00h	1.00h		1.00h	3.10h	1.00h
10.	Thm. Seedless	1.00h	5.50h	1.00h	91.20c-h		81.50c-h	7.70h	163.70a-h
11.	Queen Golden	1.00h	26.50gh	37.80gh	52.00f-h		15.20gh	52.50f-h	12.3h

Interaction SE± 47.57

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

When the effect of propagating media on the root length of 6 weeks callused cuttings were studied, it was found that the media fell into two non significant groups, consisting of the three potting mixtures (I-III), sand and grit on one hand and sand, grit rice-hull and sawdust on the other. The 3 potting mixtures were found to give longer roots than rice-hull and sawdust.

A critical study of the varieties revealed that the differences in all the three periods of callusing were highly significant

In experiment with the fresh cuttings, Anab-e-shahi gave the highest root length, followed by Bangalore blue. While in the 3 weeks callused trial, Anab x American seedling gave longer roots than all other varieties tested, except Black hamburgh and Catawaba. Similarly in the 6 weeks callused experiment, the hybrid Anab x American seedling produced longer roots than all other varieties under trial.

The interaction between rooting media and varieties was found to be significant (at 1%) only for the fresh cutting trial (Table 14.11c). When same rooting medium was studied in relation to different varieties, it was found that rice-hull and PMsI and II did not show differential response, however when the same variety was considered in relation to different rooting media, a differential response was observed for the varieties Anab-e-shahi, Bangalore blue and Ex-Zaria-black.

A non significant group of longest roots was found for Anab-e-shahi in all the media tested, except PMII, for Anab x American hybrid in PMI, Bangalore blue in grit, sand, sawdust and PMIII, Black hamburgh in PMI and Ex-Zaria-black in sawdust.

4.12 Root Volume

The root volume (ml/plt) as affected by rooting media and variety at 0, 3 and 6 weeks after callusing is shown in table 4.12a and the corresponding analysis of variance is given in table 4.12b.

Statistical analysis of data on rooting media revealed that mean root volume was highly significant at 0 callsing period, and not significant at both 3 and 6 weeks callus periods.

Sand gave higher mean root volume than all other media except PMII. When the varieties were considered, the differences among varieties for the three periods of callusing was found to be highly significant. At 0 period of callusing, the hybrid, Anab x American seedling produced highest root volume. This was followed by Black hamburgh. Anab x American seedling gave higher root volume than all other varieties tested except Black hamburgh and MKM-7 in 6 weeks callused trials respectively. A close study of the interaction between rooting media and variety for the fresh

Table 4.12a: Root volume (ml) as affected by rooting medium and variety in grapes during the 1992 dry season

Treatments	Uncallused Cutting	Callus periods(wk 3	6
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	1.46cd	1.03	1.17
Soil: FYM: Sand (25% 25% 50%)	1.15d	1.08	1.19
Soil: FYM: Sand (12.5% 12.5% 75%)	2.33ab	1.24	1.18
Sand (100%)	2.70a	1.27	1.10
Grit (100%)	1.64cd	1.16	1.09
Rice-hull (100%)	1.70b-d	1.24	1.00
Sawdust (100%)	2.00bc	1.10	1.00
SE ±	0.22	0.08	0.06
Significance	**	NS	NS
Varieties:			
Anab-e-Shahi	1.60c-e	1.05cd	1.01b
Anab x Amer	3.80a	1.60a	1.43a
Bangl. Blue	1.94c	1.09cd	1.01b
Blk Hamb.	2.71b	1.39ab	1.22ab
Cardinal	1.41c-e	1.04cd	1.00b
Catawaba	1.85c	1.25bc	1.12b
Ex-Zaria Blk	1.10de	1.00d	1.01b
MKM-7	1.73cd	1.18b-d	1.20ab
Regina	1.45c-e	1.00d	1.10b
Thomp. Sdl.	1.01de	1.03cd	1.00b
Queen Gol.	2.00c	1.15b-d	1.00b
SE ±	0.22	0.08	0.08
Significance	**	**	**
Interaction:			
Rooting media x Variety			
Significance	**	NS	NS

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability. * and ** = significant at 5 and 1 percent levels respectively NS = not significant.

Table 4.12b Analysis of variance for root volume (ml) at the 3 callusing periods

		Uncallused cutting		Callus periods (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	2.286	1.11	0.5415	2.00	0.138	0.53
R.media	6	18.362	5.96	0.5988	1.60	0.419	1.89
Error (a)	30	3.081	1.50	0.3722	1.37	0.221	0.85
Varieties (V)	10	27.687	13.49	1.4601	5.39	0.793	3.05
Int. M x V	60	5.046	2.46	0.2561	0.94	0.211	0.81
Error (b)	350	2.051		0.2704		0.260	

Table 4.12c: Root volume (ml) for fresh cutting as affected by interaction of rooting medium and variety in grapes during the 1992 dry season.

Main Tr. / Sub. Tr.	100 percent of Grit	Sand	S/Dst.	R/Hull	Percent Composition of T/Soil	37.5	25.0	12.5
					F.Y.M.	37.5	25.0	12.5
					Sand	25.0	50.0	75.0
1. Anab-e-Shahi	1.17h	2.50c-h	1.42gh	1.00h		1.75e-h	1.50gh	1.83d-f
2. Anab x Amer Sed.	3.58b-f	7.85a	3.75b-f	3.17c-h		2.08d-h	1.67f-h	4.52bc
3. Bang. Blue	2.00d-h	1.17h	1.75e-h	1.33h		2.00d-h	1.42gh	3.92b-e
4. Bl. Hambourg	3.00c-h	5.50b	3.08c-h	2.03d-h		1.67f-h	1.00h	2.67c-h
5. Cardinal	1.42gh	1.33h	1.00h	1.00h		1.17h	1.00h	1.03h
6. Catawaba	1.00h	3.00c-h	1.92d-h	2.17d-h		1.08h	1.00h	2.75c-h
7. Ex-Zaria Bl.	1.17h	1.33h	1.03h	1.00h		1.08h	1.00h	1.08h
8. MKM-7	1.67f-h	1.17h	3.75b-f	1.87d-h		1.00h	1.00h	1.67f-h
9. Regina	1.08h	3.83b-f	1.08h	1.00h		1.00h	1.00h	1.17h
10. Thm. Seedless	1.00h	1.00h	1.00h	1.00h		1.00h	1.03h	1.00h
11. Queen Golden	1.00h	1.00h	1.72f-h	3.17c-h		2.17d-h	1.00h	3.95b-d

Interaction SE± 0.60

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

cuttings (Table 4.12c), revealed that there was no significant difference among all the eleven varieties for production of rooot volumes in potting mixtrues I, II and rice-hull. When the same variety was examined in different propagating media tested, no differential response in varieties - cardinal, Catawaba, Ex-Zaria-black, and Thompson seedless was noticed. The highest root volume was recorded by Anab x American hybrid in sand followed by Black hamburgh in the same rooting medium which constituted a non significant group with Anab x American seedling in grit, sawdust, PMIII, Bangalore blue in PMIII, MKM-7 in sawdust, Regina in sand and Queen golden in PMIII.

4.13 Root fresh weight

The effect of rooting media and varieties on root fresh weight at 0, 3 and 6 weeks after callusing is given in table 4.13a and the corresponding analysis of variance is shown in table 4.13b.

Statistical analysis of data on the rooting media revealed that mean root fresh weight was highly significant for fresh cuttings and significant at 5% level for 6 weeks callused tials. When the means of the fresh cutting trial were compared for their significance they fell into two non-significant groups of PMIII and 100% sand for the first group and the rest of the rooting media tested constitutes

Table 4.13a: Roots fresh weight (g) as influenced by rooting medium and variety in grapes during the 1992 dry season

Treatments	Uncallused Cutting	Callus periods(wk 3	6
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	1.71b	1.09	1.31a
Soil: FYM: Sand (25% 25% 50%	1.23b	1.20	1.42a
Soil: FYM: Sand (12.5% 12.5% 75%)	3.13a	1.50	1.28a
Sand (100%)	3.66a	1.67	1.20ab
Grit (100%)	1.85b	1.51	1.20ab
Rice-hull (100%)	1.52b	1.88	1.00b
Sawdust (100%)	1.77b	1.42	1.00b
SE ±	0.27	0.23	0.09
Significance	**	NS	*
Varieties:			
Anab-e-Shahi	2.03cd	1.00e	1.11bc
Anab x Amer	4.82a	2.67a	1.83a
Bangl. Blue	1.97cd	1.25c-e	1.09bc
Blk Hamb.	3.32b	2.18ab	1.34bc
Cardinal	1.27d	1.11de	1.00c
Catawaba	1.99cd	1.79bc	1.30bc
Ex-Zaria Blk	1.12d	1.00e	1.06bc
MKM-7	1.69cd	1.64cd	1.44b
Regina	1.59cd	1.00e	1.05c
Thomp. Sdl.	1.09d	1.00e	1.00c
Queen Gol.	2.37c	1.50c-e	0.12
SE ±	0.33	0.18	
Significance	**	**	**
Interaction:			
Rooting media x Variety			
Significance	**	**	NS

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability. * and ** = significant at 5 and 1 percent levels respectively NS = not significant.

Table 4.13b Analysis of variance for root fresh weight (g) at the 3 callusing periods

		Uncallused cutting		Callus periods (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	3.273	0.70	2.269	1.59	0.529	0.82
R.media	6	54.612	11.31	4.734	1.39	1.618	3.21
Error (a)	30	4.827	1.03	3.393	2.37	2.786	4.32
Varieties (V)	10	50.856	10.95	13.156	9.21	0.587	0.91
Int. M x V	60	9.893	2.13	1.482	1.03	0.644	
Error (b)	350	4.644		1.427			

Table 4.13c: Root fresh weight (g) for fresh cutting as affected by interaction of rooting medium and variety in grapes during the 1992 dry season.

	Main Tr. / Sub. Tr.	100 percent of Grit	Sand	S/Dst.	R/Hull	Percent Composition of T/Soil / F.Y.M. / Sand	37.5 / 37.5 / 25.0	25.0 / 25.0 / 50.0	12.5 / 12.5 / 75.0
1.	Anab-e-Shahi	1.22fg	4.14c-f	1.00g	1.46fg		2.05e-g	1.60e-f	2.76d-f
2.	Anab x Amer Sed.	4.70c-e	10.79a	2.81d-g	1.67e-g		3.74d-f	2.00e-g	8.07ab
3.	Bang. Blue	2.30e-g	1.90e-g	1.66e-g	1.29fg		1.61e-g	1.48fg	3.54d-f
4.	Bl. Hambourg	3.41d-f	7.07dc	2.58d-g	1.99e-g		1.42fg	1.00g	5.78b-d
5.	Cardinal	1.40fg	2.25e-g	1.00g	1.00g		1.23fg	1.00g	1.00g
6.	Catawaba	1.00g	4.31c-f	1.80e-g	1.79e-g		1.21fg	1.00g	2.64d-g
7.	Ex-Zaria Bl.	1.45fg	1.00g	1.09g	1.00g		1.19fg	1.12fg	1.00g
8.	MKM-7	1.75e-g	1.58e-g	3.00d-g	1.80e-g		1.00g	1.00g	1.69e-g
9.	Regina	1.15fg	4.70c-e	1.07g	1.00g		1.00g	1.19fg	1.00g
10.	Thm. Seedless	1.00g	1.50fg	1.00g	1.00g		1.00g	1.00g	1.16fg
11.	Queen Golden	1.00g	1.00g	1.76e-g	2.70d-g		3.40d-f	1.10g	5.64b-e

Interaction SE± 0.88

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.13d: Root fresh weight (g) for 3 weeks callused cutting as affected by interaction of rooting media and variety in grapes during the 1992 dry season.

	Main Tr. / Sub. Tr.	100 percent of Grit	Sand	S/Dst.	R/Hull	Percent Composition of T/Soil / F.Y.M. / Sand	37.5 / 37.5 / 25.0	25.0 / 25.0 / 50.0	12.5 / 12.5 / 75.0
1.	Anab-e-Shahi	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
2.	Anab x Amer Sed.	3.81a	4.09a	1.62b-d	3.21a-b		1.66b-d	1.40cd	2.86a-d
3.	Bang. Blue	1.30d	1.29d	1.00d	1.36cd		1.25d	1.00d	1.56b-d
4.	Bl. Hambourg	1.85b-d	2.65a-d	1.52b-d	2.69a-d		1.00d	2.21a-d	3.38ab
5.	Cardinal	1.00d	1.00d	1.00d	1.58b-d		1.00d	1.00d	1.18d
6.	Catawaba	2.46a-d	1.93b-d	2.41a-d	2.34a-d		1.06d	1.28d	1.06d
7.	Ex-Zaria Bl.	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
8.	MKM-7	1.00d	1.57b-d	2.23a-d	2.87a-d		1.00d	1.36cd	1.41cd
9.	Regina	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
10.	Thm. Seedless	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d
11.	Queen Golden	1.17d	1.79b-d	1.88b-d	2.67a-d		1.00d	1.00d	1.50b-d

Interaction SE± 0.52

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

the second group. 3 weeks callusing did not affect the mean root fresh weight significantly. In trial with 6 weeks callused cuttings, the three potting mixtures gave statistically heavier fresh root weight than rice-hull and sawdust.

When the varieties were considered, the hybrid Anab x American seedling was found to produce the heaviest fresh root weight in all the three experiments. In the 3 weeks callused trial however, it's root fresh weight was statistically same with those of Black hamburgh. The interaction between rooting media and varieties was found to be highly significant at 0 and 3 weeks callused periods. When the interaction at 0 period of callusing (Table 4.13c) was examined critically, it was noted that there was no difference among all the eleven varieties for the production of fresh root weight in PMII, rice-hull and sawdust.

When the same variety was studied in different rooting media, there was differential response for all except cardinal, Ex-Zaria-black, MKM-7 and Thompson seedless. The varieties Anab-e-shahi, Anab x American hybrid, Black hamburgh, Catawaba and Regina all produced heavier fresh roots in sand, however, Queen Golden and Bangalore blue gave heavier fresh root weight in PMIII. Fresh root

weights produced by Anab x American hybrid and Black hamburgh in sand is also at par with those produced by these varieties in PMIII.

Interaction for the 3 weeks callused cuttings (Table 4.13d showed no significant difference among all the eleven varieties tested for the production of root fresh weight in PMI, II and sawdust. When the same variety was examined in different rooting media, the variety Black hamburgh and Anab x American hybrid exhibited differential responses. The hybrid Anab x American seedling gave heavier fresh roots in all the media tested except in PMI, II and sawdust while Bangalore blue also produced heavier fresh roots in all the media under trial except PMI, grit and sawdust.

4.14 Root dry weight

The root dry weight (g/plt) as affected by rooting media and variety at 0, 3 and 6 weeks after callusing is shown in table 4.14a and the corresponding analysis of variance is given in table 1.14b.

Statistical analysis of data on the rooting media revealed that mean root dry weight was highly significant at 0 period of callusing and significant at 5% level for 6 weeks callused experiments respectively. In experiment with

Table 4.14a: Root dry weight (g) as affected by rooting medium and variety in grapes during the 1992 dry season

Treatments	Uncallused Cutting	Callus periods(wk 3	6
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	1.14b	1.01b	1.07a
Soil: FYM: Sand (25% 25% 50%)	1.08b	1.03b	1.08a
Soil: FYM: Sand (12.5% 12.5% 75%)	1.49a	1.08b	1.06ab
Sand (100%)	1.69a	1.06b	1.04ab
Grit (100%)	1.10b	1.09b	1.05ab
Rice-hull (100%)	1.11b	1.36a	1.00b
Sawdust (100%)	1.15b	1.19ab	1.00b
SE ±	0.08	0.07	0.02
Significance	**	**	**
Varieties:			
Anab-e-Shahi	1.30b	1.00c	1.03b
Anab x Amer	1.85a	1.35a	1.19a
Bangl. Blue	1.25b	1.05c	1.02b
Blk Hambled	1.42b	1.29ab	1.06b
Cardinal	1.11b	1.02c	1.00b
Catawaba	1.27b	1.24ab	1.06b
Ex-Zaria Blk	1.09b	1.00c	1.01b
MKM-7	1.05b	1.17a-c	1.08b
Regina	1.17b	1.00c	1.02b
Thomp. Sdl.	1.05b	1.00c	1.00b
Queen Gol.	1.21b	1.16bc	1.00b
SE ±	0.12	0.06	0.03
Significance	**	**	**
Interaction:			
Rooting media x Variety			
Significance	**	NS	NS

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability. * and ** = significant at 5 and 1 percent levels respectively NS = not significant.

Table 4.14b Analysis of variance for root dry weight (g) at the 3 callusing periods

		Uncallused cutting		Callus periods (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	0.651	1.07	0.065	0.47	0.021	0.63
R.media	6	3.736	8.22	0.935	3.30	0.071	2.63
Error (a)	30	0.454	0.74	0.284	2.07	0.027	0.82
Varieties (V)	10	2.191	3.61	0.717	5.23	0.133	4.07
Int. M x V	60	0.790	1.30	0.125	0.91	0.029	0.87
Error (b)	350	0.607		0.137		0.033	

Table 4.14c: Root dry weight (g) for fresh cutting as influenced by interaction of rooting medium and variety in grapes during the 1992 dry season

Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	S/Ost.	R/Hull	Percent Composition of: T/Soil	37.5	25.0	12.5
					P.Y.M.	37.5	25.0	12.5
					Sand	25.0	50.0	75.0
1. Anab-e-Shahi	1.04ef	1.60c-f	1.74c-f	1.24d-f		1.14ef	1.25d-f	1.11ef
2. Anab x Amer Sed.	1.41c-f	2.89ab	1.06ef	1.03ef		1.58c-f	1.47c-f	3.51a
3. Bang. Blue	1.13ef	1.19ef	1.36d-f	1.16ef		1.13ef	1.06ef	1.70c-f
4. Bl. Hambourg	1.41c-f	2.37b-d	1.00f	1.00f		1.13ef	1.00f	2.03a-e
5. Cardinal	1.02ef	1.48c-f	1.10ef	1.18ef		1.00f	1.00f	1.00f
6. Catawaba	1.00f	2.49a-c	1.01ef	1.00f		1.08ef	1.00f	1.32d-f
7. Ex-Zaria Bl.	1.02ef	1.12ef	1.27d-f	1.17ef		1.03ef	1.00f	1.01ef
8. NKM-7	1.12ef	1.08ef	1.02ef	1.00f		1.00f	1.05ef	1.10ef
9. Regina	1.00f	2.13b-e	1.00f	1.00f		1.00f	1.00f	1.00f
10. Thm. Seedless	1.00f	1.00f	1.00f	1.32d-f		1.00f	1.00f	1.00f
11. Queen Golden	1.00f	1.25d-f	1.13ef	1.07ef		1.41c-f	1.05ef	1.59c-f

Interaction SE± 0.31

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

fresh cuttings, the rooting media sand and PMIII produced significantly heavier dry roots when compared with all other rooting media tested, which constituted another non significant group. For the 3 weeks callused trials, all the rooting media fall into 2 non significant groups of rice-hull which was significantly at par with sawdust and the sawdust with the rest of the media tested. At 6 weeks after callusing, PMI and II produced more dry leaf weight than rice-hull and sawdust.

When the varieties where considered, the differences in the mean root dry weight were highly significant in all the 3 periods of callusing. In trials with fresh cutting, the hybrid Anab x American seedling produced significantly heavier dry roots than all other varieties on trial which constituted a non significant group. At 3 weeks of callusing, the hybrid Anab x American seedling again produced highest mean root dry weight than other varieties except Black hamburgh, Ex-Zaria-black and MKM-7. In 6 weeks callused experiment, like fresh cuttings the hybrid Anab x American produced higher root dry weight than all other varieties which fall into a single non significant group.

Interaction between rooting media and varieties was only highly significant in the fresh cutting experiment (Table 4.14c). PMI, II, grit sawdust and rice-hull did not show any differential response due to varieties. In both

PMIII and sand, the hybrid Anab x American seedling produced highest root dry weight. When the same variety was examined in different media for root dry weight production, it was observed that Anab x American seedling, Black hamburg, Catawaba and Regina exhibited differential response in different media. Anab x American hybrid gave best performance with respect to root dry weight in PMIII, this was statistically same that produced by the same variety in sand. Black hamburgh also gave higher root dry weight in PMIII, Catawaba and Regina produced significantly higher root dry weight in sand.

4.15 Weight loss per cutting

The effect of rooting media and varieties on weight loss per cuttings at 0, 3 and 6 weeks periods of callusing is shown in table 4.15a and the corresponding analysis of variance is given in table 4.15b.

Statistical analysis of data for the rooting media of rooting media and varieties on shoot fresh weight (g/plt) at 0, 3 and 6 weeks after callusing is given in table 4.7a and the corresponding analysis of variance is shown in table 4.7b.

Analysis of data on propagating media revealed that mean shoot fresh weight was significant at 5% level only for the 3 weeks callus trial. Rice-hull gave significantly

Table 4.15a: Weight loss (g) per cutting as affected by roting medium and variety in grapes during the 1992 dry season.

Treatments	Uncallused Cutting	Callus periods(wks 3	6
Rooting Media:			
Soil: FYM: Sand (37.5% 37.5% 25%)	1.09	0.74ab	0.97a
Soil: FYM: Sand (25% 25% 50%)	0.94	0.63b	0.87a
Soil: FYM: Sand (12.5% 12.5% 75%)	1.28	1.67a	0.84a
Sand (100%)	1.18	1.02a	0.73ab
Grit (100%)	0.94	0.56b	0.78a
Rice-hull (100%)	0.93	0.51b	0.84a
Sawdust (100%)	1.00	0.55b	0.45b
SE ±	0.11	0.10	0.10
Significance	NS	**	**
Varieties:			
Anab-e-Shahi	1.18bc	0.48b	0.86b
Anab x Amer	1.90a	1.10a	1.52a
Bangl. Blue	1.18bc	0.75b	0.75b
Blk Hambled	1.42b	1.11a	0.82b
Cardinal	0.60c	0.46b	0.57b
Catawaba	0.94c	0.61b	0.83b
Ex-Zaria Blk	0.80c	0.51b	0.62b
MKM-7	1.06c	0.68b	0.77b
Regina	0.87c	0.46b	0.63b
Thomp. Sdl.	0.68c	0.48b	0.56b
Queen Gol.	0.96c	0.73b	0.63b
SE ±	0.12	0.11	0.10
Significance	**	**	**
Interaction:			
Rooting media x Variety			
Significance	**	NS	NS

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability. * and ** = significant at 5 and 1 percent levels respectively NS = not significant.

Table 4.15b Analysis of variance for Weight loss (g) per cutting at the 3 callusing periods.

		Uncallused cutting		Callus periods (wks) 3		6	
Source	DF	MS	F	MS	F	MS	F
Replication	5	0.745	1.33	5.22	9.84	3.896	9.53
R.media	6	1.242	1.55	2.028	3.14	1.802	2.59
Error (a)	30	0.7999	1.43	0.645	1.21	0.694	1.69
Varieties (V)	10	5.675	10.19	2.459	4.63	2.980	7.29
Int. M x V	60	0.689	1.23	0.515	0.97	0.538	1.31
Error (b)	350	0.557		0.5305		0.408	

Table 4.15c: Weight loss (g) per cutting for fresh cuttings as affected by interaction of rooting medium and variety in grapes during the 1992 dry season.

		100 percent of				Percent Composition of			
	Main Tr.	Grit	Sand	S/dust	R/Hull	I/Soil	37.5	25.0	12.5
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5
						Sand	25.0	50.0	75.0
1.	Anab-e-Shahi	1.07d-i	1.56a-i	1.14c-i	1.42b-i		0.91e-i	0.67g-i	1.52b-i
2.	Anab x Amer Sed.	1.33b-i	1.91a-e	2.25a-c	2.06a-d		2.05a-d	1.34b-i	2.36ab
3.	Bang. Blue	0.80e-i	0.92e-i	1.08d-i	1.60a-h		1.20c-i	1.21c-i	1.40b-i
4.	Bl. Hambourg	1.41b-i	2.56a	1.04d-i	1.00d-i		1.84a-f	0.91e-i	1.18c-i
5.	Cardinal	0.71g-i	0.63g-i	0.46i	0.59hi		0.45i	0.68g-i	0.64g-i
6.	Catawaba	0.78f-i	1.08d-i	1.53c-i	0.65g-i		0.78f-i	0.84e-i	0.91e-i
7.	Ex-Zaria Bl.	0.79e-i	0.72f-i	0.75f-i	0.29i		1.20c-i	1.21c-i	0.59hi
8.	MKM-7	0.67g-i	1.23c-i	1.08d-i	0.72f-i		1.28b-i	1.15c-i	1.31b-i
9.	Regina	1.22c-i	0.68g-i	0.46i	0.60hi		0.69g-i	0.73f-i	1.74a-g
10.	Thm. Seedless	0.74f-i	0.72f-i	0.62hi	0.45i		0.95d-i	0.60hi	0.70f-i
11.	Queen Golden	0.82e-i	1.02d-i	0.63hi	0.78f-i		0.69g-i	1.05d-i	1.74a-g

Interaction SE± 0.31

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.15d: Weight loss (g) per cutting for 6 weeks callused cutting as affected by interaction of rooting medium and variety in grapes during the 1992 dry season.

	Main Tr.	100 percent of				Percent Composition of			
	Sub. Tr.	Grit	Sand	S/Ost.	R/Hull	T/Soil	37.5	25.0	12.5
						F.Y.M.	37.5	25.0	12.5
						Sand	25.0	50.0	75.0
1.	Anab-e-Shahi	0.77d-g	0.67e-g	0.48fg	0.92c-g		1.05c-g	1.18b-g	1.1.95c-g
2.	Anab x Amer Sed.	2.55a	1.07c-g	0.62fg	1.67a-e		2.12ab	0.83d-g	1.90a-c
3.	Bang. Blue	0.47g	0.68e-g	0.45fg	0.82d-g		0.87d-g	1.03c-g	0.93c-g
4.	Bl. Hambourg	0.50fg	0.78d-g	0.42fg	0.73d-g		1.75a-d	0.77d-g	0.77d-g
5.	Cardinal	0.35g	0.78d-g	0.53fg	0.65fg		0.53fg	0.50fg	0.62fg
6.	Catawaba	1.19b-g	1.40b-f	0.40fg	0.77d-g		0.55fg	0.77d-g	0.47fg
7.	Ex-Zaria Bl.	0.45fg	0.58fg	0.33g	0.63fg		0.53fg	0.93c-g	0.90c-g
8.	MKM-7	0.80d-g	0.80d-g	0.60fg	0.57fg		1.02c-g	1.07c-g	0.55fg
9.	Regina	0.49fg	0.43fg	0.35g	0.67e-g		0.67e-g	0.95c-g	0.83d-g
10.	Thm. Seedless	0.47fg	0.50fg	0.42fg	0.78d-g		0.52fg	0.72d-g	0.52fg
11.	Queen Golden	0.58fg	0.48fg	0.30g	1.03c-g		0.72d-g	0.83d-g	0.82d-g

Interaction SE± 0.28

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

heavier fresh shoot than all other media under trial except grit and sand.

When the varieties were studied closely, it was found that the differences were highly significant for all the three periods of callusing. In trials with fresh cuttings, the varieties Black hamburgh gave significantly higher fresh shoot weight than all other varieties tested. This was followed by Catawaba, Cardinal, Thompson seedless, MKM-7, Anab x American hybrid and Bangalore blue which fall into a non-significant group. However, fresh shoot weight of Catawaba was significantly higher than those of Queen golden, Ex-Zaria-black, Regina and Anab-e-shahi. At 3 weeks callus period, Anab x American hybrid produced higher fresh shoot weight than all other varieties except Black hamburgh which was significantly at par with Catawaba, Queen golden and MKM-7, and significantly higher than the rest of the varieties tested. While in experiment with 6 weeks callus cuttings, Anab x American hybrid and MKM-7 yielded higher shoot fresh weight than all other varieties on trial which constituted a second non significant group.

4.16 Number of Leaves

4.16.1 Number of leaves in fresh cuttingh experiment at 2 WAP

The effect of rooting media, varieties and their interactions on number of leaves produced in fresh cuttings 2 WAP is shown in table 4.16.1.

Table 4.16.1 Effect of rooting medium x variety on number of leaves at 2 weeks after planting (WAP) in fresh cutting experiment during 1992 dry season.

	Main Tr.	100 percent of				Component percent			
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	T/Soil F.Y.M. Sand	37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0	Means SE± 0.28
1.	Anab-e-Shahi	3.83a-c	3.33a-e	3.33a-e	2.00a-f		1.50d-f	3.17a-f	3.50a-d	2.95ab
2.	Anab x Amer Sed.	3.33a-e	3.50a-d	4.00ab	1.50d-f		2.67a-f	3.17a-f	4.00ab	3.17a
3.	Bang. Blue	2.50a-f	1.00f	1.67c-f	1.00f		2.83a-f	2.67a-f	1.33d-f	1.86c-e
4.	Bl. Hambourg	3.33a-e	3.33a-e	3.00a-f	1.17ef		1.50d-f	1.83b-f	3.17a-f	2.48a-c
5.	Cardinal	1.33d-f	1.00f	1.00f	1.00f		1.33d-f	1.00f	1.00f	1.10e
6.	Catawaba	1.00f	1.00f	1.17ef	1.17ef		3.50a-d	1.33d-f	1.67c-f	1.55c-e
7.	Ex-Zaria Bl.	2.17a-f	2.67a-f	3.50a-d	1.17ef		3.83a-c	4.17a	2.67a-f	2.86ab
8.	MKM-7	2.50a-f	2.00a-f	3.00a-f	1.33d-f		2.00a-f	2.00a-f	1.50d-f	2.05b-d
9.	Regina	1.00f	1.33d-f	1.00f	1.00f		1.83b-f	1.00f	1.83b-f	1.29de
10.	Thm. Seedless	2.00a-f	1.17ef	1.00f	1.50d-f		1.00f	2.00a-f	1.00f	1.38de
11.	Queen Golden	1.17ef	1.17ef	2.33a-f	1.00f		1.67c-f	2.17a-f	2.50a-f	1.71c-e
		Interaction SE± 0.62								
	Mean SE ± 0.20	2.20ab	1.96b	2.27a	1.26c		2.14ab	2.23ab	1.9b	

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

The effect due to media and varieties was significant at 5 and 1% levels respectively for fresh cuttings 2 WAP. When the rooting media means were considered, it was observed that sawdust produced significantly higher number of leaves than all others except PMII, grit and PMI in that order.

Among varieties, Anab x American seedling produced higher number of leaves than others but was statistically at par with Anab-e-shahi, Ex-Zaria-black and Black hamburgh.

The interaction between rooting media and varieties was highly significant when same medium was considered viz-a-viz the varieties, there was differential responses in all the media tested except rice-hull. When the same variety was studied in relation to different media, the varieties Anab-e-shahi, Anab x American hybrid, Black hamburgh, Catawaba and Ex-Zaria-black responded differentially to different propagating media. Higher number of leaves were recorded in a rooting media and variety combination of Ex-Zaria-black and Anab x American hybrid in all the media, except rice-hull, Anab-e-shahi in all the media except PMI, Bangalore blue in PMI, II and grit, Catawaba in PMI, MKM-7 in all the media tested except rice-hull and PMIII, Thompson seedless in grit and PMIII, sawdust and PMII which constituted the same significant group.

4.16.2. Number of leaves in fresh cuttings experiment at 5 WAP

Table 4.16.2. shows the effect of rooting media, varieties and their interactions on the number of leaves produced in fresh cuttings 5 WAP.

The effect of media and varieties were found to be highly significant for fresh cutting, 5WAP. When the Propagating media means were compared, it was observed that PMIII gave higher number of leaves than other media tested except sand and sawdust.

Among varieties Anab x American seedling produced higher number of leaves which was at par with those given by Anab-e-shahi, Bangalore blue, Queen golden and MKM-7. The interaction between rooting media and varieties was highly significant. When the same medium was studied viz-a-viz the different varieties, there was noticed a differential responses in all the media except in case of PMI. When the same variety was considered in relation to different media there was differential responses in all except the varieties Catawaba, Ex-Zaria-black and Regina. Higher number of leaves were produced in rooting media x varietal combination of Anab-e-shahi in sand which was statistically at par as the same variety in grit, Anab x American hybrid in PMIII and sawdust, Bangalore blue in PMIII, sand and grit, cardinal in PMIII, MKM-7 in sand, Thompson seedless in PMIII and Queen golden in sawdust and rice-hull.

Table 4.16.2 Effect of rooting medium x variety on number of leaves at 5WAP in fresh cutting experiment during 1992 dry season.

		100 percent of				Component percent				
	Main Tr.	Grit	Sand	Sawdust	Rice-hull	T/Soil	37.5	25.0	12.5	Means
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5	SE± 0.36
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	4.33a-g	7.83a	2.83b-g	2.67c-g		1.83e-g	2.17e-g	4.00b-g	3.67ab
2.	Anab x Amer Sed.	3.00b-g	2.83b-g	6.00ab	3.33b-g		2.67c-g	2.00ef	6.33ab	3.74a
3.	Bang. Blue	4.83a-f	5.67a-d	2.50c-g	1.17g		3.67b-g	1.00g	5.00a-e	3.40a-c
4.	Bl. Hambourg	1.17g	1.17g	4.00b-g	2.00ef		2.67c-g	1.00g	1.00g	1.86de
5.	Cardinal	2.00ef	2.83b-g	1.00g	1.17g		2.33d-g	1.00g	4.83a-e	2.17de
6.	Catawaba	2.83b-g	3.00b-g	2.50c-g	1.50fg		1.33fg	1.00g	4.00b-h	2.31c-e
7.	Ex-Zaria Bl.	3.17b-g	1.17g	3.17b-g	1.00g		3.50b-g	1.50fg	4.00b-g	2.50b-e
8.	MKM-7	1.50fg	4.83a-f	3.33b-g	2.50c-g		1.67fg	1.67fg	2.67c-g	2.60a-e
9.	Regina	1.00g	1.00g	2.33d-g	2.17e-g		1.83e-g	1.00g	1.00g	1.48
10.	Thm. Seedless	2.67c-g	2.17e-g	1.00g	1.00g		1.17g	4.00b-g	5.33a-d	2.48b-e
11.	Queen Golden	1.67fg	2.33d-f	5.33a-d	4.17a-g		1.17g	2.83b-g	3.83b-g	3.05a-d
	Interaction SE± 0.97									
	Mean	2.56bc	3.17ab	3.09ab	2.06c		2.17bc	1.74c	3.82a	
	SE± 0.31									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

4.16.3. Number of leaves in fresh cuttings experiment at 8 WAP

The effect of rooting media varieties and their interactions the number of leaves produced in fresh cuttings at 8 WAP is shown in table 4.16.3.

The effect due to propagating media was not significant, while that due to varieties was highly significant. When the varietal means were critically studied, Anab x American seedling produced significantly higher number of leaves than all other varieties under trial except Bangalore blue, Queen golden and black hamburgh.

The interaction between rooting media and varieties was also highly significant. When the same medium was compared in respect to the different varieties, there was differential response in all the rooting substrates except PMI, grit and sawdust. When the same variety was considered in different media, differential responses were noticed in Anab x American seedling, Bangalore blue, Black hamburgh, Catawaba and Queen golden. Higher number of leaves were produced in a rooting media x varietal combination of Anab x American in sand, which was statistically at par with the same variety in PMIII, rice-hull, sawdust grit and PMI, Anab-e-shahi in sand, Bangalore blue in all the media under trial except rice-hull and PMII. Catawaba in sand, sawdust and rice-hull, MKM-7 in PMIII, sawdust, grit and rice-hull, Regina in sand, and Queen golden in all the media tested except PMI, sand and grit.

Table 4.16.3 Effect of rooting medium x variety on number of leaves at 8 WAP in fresh cutting experiment during 1992 dry season.

		100 percent of				Component percent				
	Main Tr.	Grit	Sand	Sawdust	Rice-hull	T/Soil	37.5	25.0	12.5	Means
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5	SE± 0.51
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.50d-f	3.00a-f	2.17b-f	1.00f		2.17b-f	2.00b-f	1.83c-f	1.95d-f
2.	Anab x Amer Sed.	4.50a-f	7.67a	5.33a-f	5.83a-f		3.17a-f	2.17b-f	6.50a-c	5.02a
3.	Bang. Blue	4.50a-f	3.17a-f	5.33a-f	4.67a-f		4.83a-f	1.50a-c	6.50a-c	4.36ab
4.	Bl. Hambourg	4.33a-f	5.00a-f	4.33a-f	2.33b-f		2.83a-f	1.00f	6.00a-e	3.69a-c
5.	Cardinal	1.33d-f	1.00f	1.00f	1.33d-f		2.17b-f	1.00f	1.00f	1.26ef
6.	Catawaba	1.00f	6.17a-d	4.17a-f	3.17a-f		1.33d-f	1.33d-f	2.67b-f	2.83b-e
7.	Ex-Zaria Bl.	2.67b-f	2.17b-f	2.00b-f	1.500d-f		3.33a-f	1.00f	1.50d-f	2.02c-f
8.	MKM-7	3.50a-f	1.83c-f	5.33a-f	3.33a-f		2.67b-f	1.17ef	5.33a-f	3.31b-d
9.	Regina	2.00b-f	3.17a-f	1.83c-f	2.67b-f		1.17ef	1.00f	1.00f	1.83d-f
10.	Thm. Seedless	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.00f
11.	Queen Golden	1.67c-f	2.00c-f	3.83a-f	6.17a-d		1.17ef	6.83ab	6.83ab	4.07ab
					Interaction SE± 1.38					
	Mean	2.55	3.29	3.30	3.00		2.35	1.82	3.65	
	SE± 0.44									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

4.16.4. Number of leaves in fresh cuttings experiment at 11 WAP

The effect of rooting media, varieties and their interactions on number of leaves produced in fresh cutting 11 WAP is shown in table 4.16.4.

The response due to rooting media and varieties were highly significant in experiment with fresh cuttings 11WAP. When the rooting media means were critically studied, sand was observed to have resulted in higher number of leaves than all other media studied except PMIII, sawdust and grit. Among varieties, Black hamburg resulted in higher number of leaves than all other varieties tested except Anab x American, Bangalore blue, these were also found to produce statistically same number of leaves as cardinal, Catawaba and MKM-7.

The interaction between rooting media and varieties was highely signicant. When different varieties were tested in same propagating medium, there was no differential response in all except sand, and PMIII. When the same variety was critically studied in different media, the hybrid Anab x American and varieties Black hamburgh, cardianal, and Catawaba responded differentially to rooting media. Higher number of leaves were recorded in rooting media x varietal combination of Black hamburgh in PMIII, and sand, Anab x American in sand, Bangalore blue in sand and PMIII, cardinal in sand and Catawaba in grit and sand.

Table 4.16.4 Effect of rooting medium x variety on number of leaves at 11WAP in fresh cutting experiment during 1992 dry season.

	Main Tr.	100 percent of				Component percent			
		Grit	Sand	Sawdust	Rice-hull	T/Soil	37.5	25.0	12.5	Means
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5	SE± 0.65
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	2.17e-g	1.00g	1.00g	1.00g		4.00b-g	4.67b-g	1.00g	2.12c-e
2.	Anab x Amer Sad.	5.83b-g	8.83a-c	5.67b-g	1.17g		2.83c-g	2.83c-g	1.00g	4.02a-d
3.	Bang. Blue	1.67fg	7.83a-f	2.00e-g	1.00g		3.33b-g	1.67fg	7.17a-g	3.52a-e
4.	Bl. Hambourg	4.17b-g	8.17a-e	4.17b-g	5.33b-g		2.33d-g	2.50d-g	13.00a	5.67a
5.	Cardinal	5.33b-g	8.50a-g	6.17b-g	3.50b-g		3.50b-g	1.00g	4.67b-g	4.67ab
6.	Catawaba	7.17a-g	9.17ab	3.00b-g	2.33d-g		1.67fg	1.00g	4.83b-g	4.17ac
7.	Ex-Zaria Bl.	1.67fg	1.00g	3.00b-g	1.00g		3.00b-g	1.00g	1.00g	1.67e
8.	MKM-7	3.50b-g	6.33b-g	3.83b-g	4.33b-g		1.00g	1.00g	5.33b-g	3.62a-e
9.	Regina	1.00g	3.00b-g	3.83b-g	1.00g		1.00g	1.17g	3.00b-g	2.00de
10.	Thm. Seedless	3.33b-g	1.17g	5.67b-g	3.33b-g		1.00g	1.00g	3.67b-g	2.74b-e
11.	Queen Golden	3.17b-g	2.83c-g	2.67c-g	1.00g		1.00g	1.00g	1.67fg	1.90de
	Interaction SE± 1.73									
	Mean	3.55a-c	5.26a	3.73ab	2.27bc		2.24bc	1.71c	4.21ab	
	SE± 0.58									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

4.16.5. Number of leaves in 3 weeks callus experiment at 2 WAP

The influence of rooting media varieties and their interactions on the number of leaves produced in the 3 weeks callus cuttings 2 WAP is shown in table 4.16.5.

The response due to media and varieties were highly significant for 3 weeks callus trials 2 WAP. When the propagating media were critically examined, it was observed that sand produced significantly higher number of leaves, this is however at par with those produced in PMIII and grit.

Among varieties, MKM-7 and Catawaba produced higher number of leaves than all others except Black hamburgh, Anab x American, Queen golden and Ex-Zaria-black.

The interaction between rooting media and varieties was also highely significant. When the same medium was considered viz-a-viz the different varieties, there was no differential response in all the media except in PMIII, and sand. When same variety was considered in relation to different media, the varieties Black hamburgh, Catawaba, and MKM-7 responded differentially to rooting media. Higher number of leaves were recorded in rooting media x varietal combination of Black hamburgh in PMIII, which was at par with that produced by the same variety in sand and PMI, Anab x American seedling in PMIII, sand and PMII, Catawaba in all the media under trial except rice-hull, PMI and III. Ex-Zaria-black in sawdust, MKM-7 in all the media tested except sawdust and PMI and finally Queen golden in sawdust, sand and PMIII which constituted a group which is statistically at par.

Table 4.16.5 Effect of rooting medium x variety on number of leaves at 2WAP in 3weeks callus cutting experiment during 1992 dry season.

	Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	Sawdust	Rice-hull	Component percent: T/Soil + F.Y.M. + Sand	37.5 + 37.5 + 25.0	25.0 + 25.0 + 50.0	12.5 + 12.5 + 75.0	Means SE± 0.11
1.	Anab-e-Shahi	1.00d	1.00d	1.00d	1.00d	1.00d	1.00d	1.00d	1.00d	1.00c
2.	Anab x Amer Sed.	1.33b-d	1.83a-d	1.00d	1.00d	1.00d	1.50a-d	2.00a-d	1.38ab	
3.	Bang. Blue	1.00d	1.00d	1.00d	1.33b-d	1.00d	1.00d	1.00d	1.05bc	
4.	Bl. Hambourg	1.00d	1.67a-d	1.00d	1.00d	1.50a-d	1.00d	2.50a	1.38ab	
5.	Cardinal	1.00d	1.00d	1.00d	1.00d	1.00d	1.00d	1.00d	1.00c	
6.	Catawaba	2.00a-d	2.17a-c	1.50a-d	1.00d	1.00d	1.50a-d	1.00d	1.45a	
7.	Ex-Zaria Bl.	1.00d	1.00d	1.50a-d	1.00d	1.00d	1.00d	1.33b-d	1.12a-c	
8.	MKM-7	1.67a-d	2.33ab	1.00d	1.67a-d	1.00d	1.50a-d	1.67a-d	1.55a	
9.	Regina	1.00d	1.00d	1.00d	1.00d	1.00d	1.00d	1.00d	1.00c	
10.	Thm. Seedless	1.17cd	1.00d	1.00d	1.00d	1.00d	1.00d	1.00d	1.02bc	
11.	Queen Golden	1.00d	1.67a-d	1.83a-d	1.00d	1.00d	1.00d	1.50a-d	1.29a-c	
	Interaction SE± 0.29									
	Mean	1.20a-c	1.42a	1.17bc	1.09c	1.05c	1.14bc	1.36ab		
	SE± 0.07									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

4.16.6. Number of leaves in 3 weeks callused experiment at 5 WAP

Table 4.16.6 shows that effect of rooting media varieties and their interactions on the numbe of leaves produced in trial with 3 weeks callus cuttings, 5 WAP.

The response due to media and varieties were found to be highly significant. When the media means were compared, it was observed that sand and grit resulted in significantly higher number of leaves than all others except PMIII and sawdust.

Among varieties, Anab x American hybrid, Catawaba and black hamburgh yielded higher number of leaves than all others except Queen golden and MKM-7 which constituted a non-significant group. The interaction between rooting media and varieties was highly significant. When the same medium was studied viz-a-viz the varieties, there were differential responses in all the media except in PMI, II and rice-hull. When the same variety was considered in relation to different rooting substrates. Higher number of leaves were produced in a rooting media x varietal combination of: Catawaba in grit, sand and sawdust, Anab x American in sand, grit, sawdust and PMII, Bangalore blue in grit, Black hamburg in PMIII, and sand, MKM-7 in sand x Queen golden in grit, sand and rice-hull.

Table 4.16.6 Effect of rooting medium x variety on number of leaves at 5WAP in 3 weeks callused cutting experiment during 1992 dry season

	Main Tr.	100 percent of				Component percent			
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil F.Y.M. Sand	37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0	Means SE± 024
1.	Anab-e-Shahi	1.00g	1.00g	1.00g	1.00g		1.00g	1.00g	1.00g	1.00c
2.	Anab x Amer Sed.	3.50a-e	4.00a-d	3.17a-g	2.17d-g		1.33e-g	1.67e-g	3.17a-g	2.71a
3.	Bang. Blue	3.00a-g	1.17fg	1.17fg	1.83d-g		1.00g	1.00g	1.50e-g	1.52bc
4.	Bl. Hambourg	1.67e-g	4.00a-d	1.00g	1.50e-g		2.67b-g	1.33e-g	4.83ab	2.43a
5.	Cardinal	1.00g	1.00g	1.00g	1.00g		1.00g	1.00g	1.00g	1.00c
6.	Catawaba	5.00a	4.67a-c	4.00a-d	1.00g		1.00g	1.17fg	1.00g	2.55a
7.	Ex-Zaria Bl.	1.50e-g	1.00g	1.00g	1.33e-g		1.00g	1.00g	1.33e-g	1.17c
8.	MKM-7	2.17d-g	3.33a-f	2.50c-g	2.17d-g		1.00g	1.67e-g	2.67b-g	2.21ab
9.	Regina	1.00g	1.33e0g	1.00g	1.00g		1.00g	1.00g	1.00g	1.05c
10.	Thm. Seedless	1.00g	1.00g	1.00g	1.00g		1.00g	1.00g	1.00g	1.00c
11.	Queen Golden	3.17a-g	2.83a-g	2.50c-g	2.83a-g		1.00g	1.00g	1.00g	2.26ab
		Interaction SE± 0.63								
	Mean SE± 0.18	2.18a	2.30a	1.76a-c	1.53bc		1.18bc	1.17c	1.77ab	

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

4.16.7. Number of leaves in 3 weeks callused experiment at 8 WAP

The effect of rooting media, varieties and their interactions on the number of leaves produced in trial with 3 weeks callus cuttings 8WAP is shown in table 4.16.7. The effect due to media and varieties were highly significant when the media means were compared, it was observed that sand produced high number of leaves than other media under trial with the exception of grit, rice-hull and sawdust which constituted the same significant group.

When the varieties were considered, Catawaba was found to yield more leaves than all others except Black hamburgh, Anab x American seedling and Queen golden. The interaction between rooting media and varieties was highly significant. When the same medium was considered with regards to the different varieties, there was no different response in all except PMIII, sand and grit. When the same variety was studied in relation to different propagating media, the varieties, Anab x American, Bangalore blue, Black hamburgh, Catawaba and Queen golden exhibited differential responses. Higher number of leaves was recorded in rooting media x varietal combination of Catawaba in grit, sand, sawdust and rice-hull, Anab x American hybrid in sand and grit, Bangalore blue in grit, Black hamburgh in sand and PMIII and Queen golden in sand and rice-hull.

4.16.7. Number of leaves in 3 weeks callused experiment at 8 WAP

The effect of rooting media, varieties and their interactions on the number of leaves produced in trial with 3 weeks callus cuttings 8WAP is shown in table 4.16.7. The effect due to media and varieties were highly significant when the media means were compared, it was observed that sand produced high number of leaves than other media under trial with the exception of grit, ricehull and sawdust which constituted the same significant group.

When the varieties were considered, Catawaba was found to yield more leaves than all others except Black hamburgh, Anab x American seedling and Queen golden. The interaction between rooting media and varieties was highly significant. When the same medium was considered with regards to the different varieties, there was no different response in all except PMIII, sand and grit. When the same variety was studied in relation to different propagating media, the varieties, Anab x American, Bangalore blue, Black hamburgh, Catawaba and Queen golden exhibited differential responses. Higher number of leaves was recorded in rooting media x varietal combination of Catawaba in grit, sand, sawdust and ricehull, Anab x American hybrid in sand and grit, Bangalore blue in grit, Black hamburgh in sand and PMIII and Queen golden in sand and ricehull.

Table 4.16.7 Effect of rooting medium x variety on number of leaves at 8WAP in 3 weeks callused cutting experiment during 1992 dry season

	Main Tr.	100 percent of				Component percent				
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil F.Y.M. Sand	37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0	Means SE± 0.29
1.	Anab-e-Shahi	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.33ef	1.05d
2.	Anab x Amer Sed.	4.33a-d	4.83a-c	3.33b-f	3.33b-f		1.33ef	2.50b-f	2.33c-f	3.14ab
3.	Bang. Blue	4.33a-d	1.50d-f	2.83b-f	2.83b-f		1.00f	1.83d-f	1.83d-f	2.26bc
4.	Bl. Hambourg	3.33b-f	6.67a	3.17b-f	3.17b-f		2.00c-f	2.33c-f	4.33a-d	3.21ab
5.	Cardinal	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.21d
6.	Catawaba	6.67a	5.33ab	3.83a-f	3.83a-f		1.00f	2.00c-f	1.50d-f	3.28a
7.	Ex-Zaria Bl.	1.00f	1.50d-f	1.00f	1.00f		1.00f	1.00f	1.17f	1.10d
8.	MKM-7	2.00c-f	2.00c-f	2.67b-f	2.00c-f		1.00f	2.17c-f	1.50d-f	1.95cd
9.	Regina	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.00d
10.	Thm. Seedless	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.00d
11.	Queen Golden	3.50b-f	4.17a-e	1.83d-f	3.83a-f		1.00f	1.00f	1.00f	2.33a-c
		Interaction SE± 0.79								
	Mean SE± 0.26	2.65a	2.70a	1.86a-c	2.21ab		1.12c	1.53bc	1.64bc	

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

4.16.8. Number of leaves in 3 weeks callused experiment at 11 WAP

Table 4.16.8 shows the effect of rooting media, varieties and their interactions on the number of leaves produced in 3 weeks callus cuttings 11 WAP.

The effect due to rooting media and varieties was significant at 5 and 1% levels respectively for 3 weeks callus trial 11 WAP. When the rooting media means were critically studied, all media produced higher number of leaves than PMI which in turn is statistically same as sawdust, PMII and III.

When the varietal means were considered, Catawaba, Anab x American and Black hamburgh produced number of leaves which were statistically at par and higher than those produced by other varieties tested in the same propagating substrate, there was no differential response in PMI and II. When the same variety was considered in relation to different media, Anab x American, Black hamburgh, Catawaba, and Queen golden were found to respond differentially to various propagating media. Higher number of leaves were produced in a rooting media x varietal combination of Catawaba in all the media tested except the three potting mixtures, Anab x American in grit, sand and sawdust, Black hamburgh in pmIII, and Queen golden in rice-hull.

4.16.9. Number of leaves in 6 weeks callused experiment at 2 WAP

Table 4.16.9 shows the effect of rooting media, varieties and their interaction on the number of leaves produced in trials with 6 weeks callus cuttings 2WAP.

Table 4.16.8 Effect of rooting medium x variety on number of leaves at 11 WAP in 3 weeks callused cutting experiment during 1992 dry season

		100 percent of				Componant percent				
	Main Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5	SE± 0.33
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.00k	1.00k	1.00k	1.00k		1.00k	1.00k	1.00k	1.00c
2.	Anab x Amer Sed.	5.80a-c	5.00a-g	4.67a-h	2.83c-k		1.00k	2.50d-k	2.67c-k	3.50a
3.	Bang. Blue	3.00b-k	1.00k	2.00f-k	2.67c-k		1.00k	2.83c-k	2.50d-k	2.21b
4.	Bl. Hambourg	2.33d-k	5.17a-f	1.00k	3.10b-k		2.17e-k	2.50d-k	4.50a-i	3.00a
5.	Cardinal	1.00k	1.00k	1.00k	1.00k		1.00k	1.00k	1.00k	1.00c
6.	Catawaba	6.83a	5.33a-e	4.67a-h	5.50a-d		1.50h-k	2.17e-k	1.33i-k	3.91a
7.	Ex-Zaria Bl.	1.00k	1.00k	1.00k	1.00k		1.00k	1.33i-k	1.00k	1.05c
8.	MKM-7	2.00f-k	2.83c-k	2.83c-k	3.00b-k		1.00k	3.00b-k	1.83g-k	2.36b
9.	Regina	1.00k	1.00k	1.00k	1.00k		1.00k	1.00k	1.00k	1.00c
10.	Thm. Seedless	1.00k	1.00k	1.00k	1.00k		1.00k	1.00k	1.00k	1.00c
11.	Queen Golden	1.83g-k	2.83c-k	2.00f-k	6.17ab		1.00k	1.00k	1.00k	2.26b
					Interaction SE± 0.90					
	Mean	2.49a	2.47a	2.02ab	2.58a		1.15b	1.76ab	1.71ab	
	SE± 0.33									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.16.9 Effect of rooting medium x variety on number of leaves at 2WAP in 6 weeks callused cutting experiment during 1992 dry season

	Main Tr.	100 percent of				Component percent				
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
						F.Y.M.	37.5	25.0	12.5	SE± 0.05
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00
2.	Anab x Amer Sed.	1.00c	1.00c	1.00c	1.00c		1.33bc	1.11bc	1.33bc	1.12
3.	Bang. Blue	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00
4.	Bl. Hambourg	1.00c	1.00c	1.00c	1.00c		1.17bc	1.17bc	1.00c	1.05
5.	Cardinal	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00
6.	Catawaba	1.17bc	1.00c	1.00c	1.00c		1.50ab	1.33bc	1.00c	1.14
7.	Ex-Zaria Bl.	1.17bc	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.02
8.	MKM-7	1.00c	1.00c	1.00c	1.00c		1.00c	1.17bc	1.83a	1.14
9.	Regina	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00
10.	Thm. Seedless	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00
11.	Queen Golden	1.00c	1.00c	1.00c	1.00c		1.17bc	1.00c	1.00c	1.02
		Interaction SE± 0.13								
	Mean	1.03	1.00	1.00	1.00		1.11	1.08	1.11	
	SE± 0.05									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Neither the rooting media nor the varieties effects were significant. The interactions between rooting media and varieties was however highly significant. When the same medium was examined viz-a-viz the different varieties, there was no differential response in all the rooting substrates except PMI and III. When the same variety was considered in relation to different media, the varieties MKM-7 and Catawaba responded differently to the different propagating media. Higher number of leaves per cutting were produced in a rooting media x varietal combination of MKM-7 in PMIII and Catawaba in PMI which constituted a non significant group.

4.16.10. Number of leaves in 6 weeks callused experiment at 5 WAP

The effect of rooting media, varieties and interactions on the number of leaves produced in trials with 6 weeks callus cuttings 5 WAP is shown on table 4.16.10.

The effect of rooting media and varieties was significant at 5 and 1% levels respectively when media means were compared, it was observed that the three potting mixtures gave significantly higher number of leaves than sawdust and ricehull.

Among varieties, MKM-7 produced higher number of leaves compared with all other varieties under trial, except Anab x American seedling and Catawaba. The interaction

Table 4.16.10 Effect of rooting medium x variety on number of leaves at 5WAP in 6 weeks callused cutting experiment during 1992 dry season

	Main Tr.	100 percent of				Component percent				
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
						F.Y.M.	37.5	25.0	12.5	SE± 0.14
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	2.67ab	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.24cd
2.	Anab x Amer Sed.	1.00c	2.17a-c	1.00c	1.00c		2.17c	2.83a	2.83a	1.86ab
3.	Bang. Blue	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00d
4.	Bl. Hambourg	1.00c	1.50c	1.00c	1.00c		2.33a-c	2.33a-c	1.17c	1.48bc
5.	Cardinal	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00d
6.	Catawaba	2.17a-c	2.33a-c	1.00c	1.00c		2.67ab	1.50c	1.33c	1.71ab
7.	Ex-Zaria Bl.	1.33c	1.00c	1.00c	1.00c		1.00c	1.50c	1.00c	1.12cd
8.	MKM-7	1.33c	1.50c	1.50c	1.00c		2.33a-c	1.83c	2.83a	1.95a
9.	Regina	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00d
10.	Thm. Seedless	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00d
11.	Queen Golden	1.00c	1.00c	1.00c	1.00c		1.83c	1.00c	1.00c	1.12cd
		Interaction SE± 0.38								
	Mean	1.32ab	1.32ab	1.05b	1.00b		1.57a	1.46a	1.50a	
	SE± 0.12									

Means followed by the same letter(s) within a treatment group for a particular character are not significa statistically at 5 percent probability.

When the same media was considered in respect to different varieties, there was differential response in all except sand, ricehull and sawdust. When the same var was examined in different media, the varieties Anab-e-shahi, Anab x American, Catawaba and MKM-7 responded differently to rooting media. Higher number of leaves were given in the rooting media x varietal combination of MKM-7 in PMIII and PMI, Anab-e-shahi in grit, Anab x American in PMII, III and sand, Black hamburgh in PMI and Catawaba in PMI, sand x grit which constituted a non significant group.

4.16.11. Number of leaves in 6 weeks callused experiment at 8 WAP

Table 4.16.11 shows the effect of rooting media, varieties and their interactions on the number of leaves produced in 6 weeks callus cuttings 8WAP.

The response of media and varieties on the number of leaves was not significant and highly significant respectively.

When the variety means were critically compared, the hybrid Anab x American gave more leaves than all others except MKM-7. The interactions between rooting media and varieties was highly significant. When the same media was considered in respect to different varieties, there was differential responses in all the media tested except sand, ricehull and sawdust. When the same variety was studied in

Table 4.16.11 Effect of rooting medium x variety on number of leaves at 8WAP in 6 weeks callused cutting experiment during 1992 dry season

	Main Tr.	100 percent of				Component percent				
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
						F.Y.M.	37.5	25.0	12.5	SE± 0.16
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00d
2.	Anab x Amer Sed.	3.83ab	1.83c-e	1.00e	1.00e		4.17a	2.67a-d	2.67a-d	2.45a
3.	Bang. Blue	1.00e	1.00e	1.00e	1.00e		1.00e	1.67c-e	1.00e	1.17d
4.	Bl. Hambourg	1.00e	1.00e	1.00e	1.00e		1.67c-e	2.50b-e	1.33de	1.36cd
5.	Cardinal	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00d
6.	Catawaba	3.00a-c	2.17c-e	1.00e	1.00e		2.67a-d	1.50c-e	1.33de	1.81bc
7.	Ex-Zaria Bl.	1.00e	1.00e	1.67c-e	1.00e		1.00e	1.50e	1.00e	1.07d
8.	MKM-7	1.67c-e	1.67c-e	1.00e	1.00e		1.67c-e	1.83c-e	4.00ab	1.93ab
9.	Regina	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.33de	1.05d
10.	Thm. Seedless	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00d
11.	Queen Golden	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00d
		Interaction SE± 0.43								
	Mean	1.50	1.29	1.06	1.00		1.56	1.52	1.52	
	SE± 0.15									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

relation to the different propagating media, the varieties Anab x American, Catawaba, and MKM-7 responded differentially to different media higher number of leaves were produced in rooting media x varietal combination of Anab x American hybrid in PMI, which was statistically at par with the other two potting mixtures, Catawaba in grit and PMI and MKM-7 in PM III.

4.16.12. Number of leaves in 6 weeks callused experiment at 11 WAP

Table 4.16.12 shows the effect of rooting media, varieties and their interactions on number of leaves produced at 11 WAP for 6 weeks callus cuttings.

The effect due to media and varieties was found to be significant at 5 and 1% levels respectively. When the rooting media means were compared, PMs I and II, were observed to produced significantly higher number of leaves per cutting than all others, except PMIII, grit and sand. Among varieties, Anab x American produced higher number of leaves than all others, except MKM-7 and Catawaba. The interaction between rooting media and varieties was highly significant. When the same medium was considered in respect to different varieties, there was a differential response in all media except ricehull, sawdust and sand. When the same variety was considered in relation to different media, Anab x American, Black hamburgh, Catawaba and MKM-7 responded differentially to propagating media. Higher number of leaves

Table 4.16.12 Effect of rooting medium x variety on number of leaves at 11WAP in 6 weeks callused cutting experiment during 1992 dry season

		100 percent of				Component percent				
	Main Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5	SE± 0.22
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	2.00d-f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.14c
2.	Anab x Amer Sed.	3.33a-e	1.83d-f	1.00f	1.00f		4.00a-d	5.00b-f	2.83b-f	2.71a
3.	Bang. Blue	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.83d-f	1.12c
4.	Bl. Hambourg	1.00f	1.50f	1.00f	1.00f		1.50ef	4.33a-c	1.00f	1.60bc
5.	Cardinal	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.00c
6.	Catawaba	2.50c-f	2.33c-f	1.17f	1.00f		4.33a-c	2.00d-f	1.33f	2.07ab
7.	Ex-Zaria Bl.	1.83d-f	1.00f	1.17f	1.00f		1.00f	1.83d-f	1.00f	1.26c
8.	MKM-7	2.00d-f	1.83d-f	1.00f	1.00f		2.00d-f	2.17c-f	5.17a	2.19ab
9.	Regina	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.00c
10.	Thm. Seedless	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.00c
11.	Queen Golden	1.00f	1.00f	1.00f	1.00f		1.00f	1.33f	1.17f	1.07c
					Interaction SE± 0.60					
	Mean	1.60a-c	1.32a-c	1.03bc	1.00c		1.71a	1.96a	1.67ab	
	SE± 0.20									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

were produced in rooting media x Varietal combination of MKM-7 in PMIII, Anab x American in PMs II, I and grit, Black hamburgh in PMII and Catawaba in PMI.

4.17. Apical shoot Length

4.17.1. Apical shoot Length in fresh cutting experiment at 2 WAP

The effect of rooting media, varieties and their interactions on apical shoot length in fresh cuttings 2WAP is shown in table 4.17.1.

The effect due to media and varieties were found to be highly significant. When the rooting media means were compared, it was observed that sand, sawdust and PMIII produced significantly longer apical shoots than all other rooting media under trial except grit.

Among varieties, Anab x American produced the longest apical shoot. This was viz by Black hamburgh and MKM-7. The interaction between rooting media and varieties was also highly significant. When the same medium was considered in respect of different varieties, there were differential responses in all except in PMs I and II. When same variety was compared in relation to different media, the varieties Anab-e-Shahi, Cardinal, Ex-Zaria black and Thompson seedless exhibited no differetal response to rooting media. Longer apical shoots were recorded in rooting media x varietal combination PMI and II, Black hamburgh in PMIII, sand and sawdust, Catawaba in sand and MKM-7 in grit and sawdust.

Table 4.17.1 Effect of rooting medium x variety on apical shoot length (cm) at 2WAP in fresh cutting experiment during 1992 dry season

	Main Tr.	100 percent of				Component percent				
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
						F.Y.M.	37.5	25.0	12.5	SE± 0.05
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.17f-h	1.33d-h	1.17f-h	1.00h		1.08gh	1.17f-h	1.17f-h	1.16c-e
2.	Anab x Amer Sed.	1.83a-c	1.97ab	2.00a	1.58a-f		1.25e-h	1.00h	2.00a	1.66a
3.	Bang. Blue	1.52b-g	1.08ab	1.42c-h	1.17f-g		1.33d-h	1.08gh	1.33d-h	1.28c
4.	Bl. Hambourg	1.50b-g	1.75a-d	1.67a-e	1.33d-h		1.25e-h	1.00h	1.67a-e	1.45b
5.	Cardinal	1.17f-g	1.00h	1.00h	1.00h		1.17f-h	1.00h	1.00h	1.05de
6.	Catawaba	1.17f-h	1.58a-f	1.50b-g	1.25e-h		1.17f-h	1.00h	1.33d-h	1.28c
7.	Ex-Zaria Bl.	1.08gh	1.27e-h	1.17f-h	1.00h		1.08	1.00h	1.00h	1.09de
8.	MKM-7	1.67a-e	1.00h	1.67a-e	1.17f-h		1.00h	1.00h	1.50b-g	1.29bc
9.	Regina	1.00h	1.50b-g	1.17f-h	1.00h		1.00h	1.00h	1.00h	1.10de
10.	Thm. Seedless	1.00h	1.00h	1.00h	1.00h		1.00h	1.00h	1.00h	1.00e
11.	Queen Golden	1.15f-h	1.22e-h	1.08gh	1.08gh		1.17f-h	1.00h	1.53b-g	1.18cd
		Interaction SE± 0.13								
	Mean	1.30ab	1.34a	1.35a	1.14bc		1.14bc	1.02c	1.32a	
	SE± 0.05									

Means followed by the same letter(s) within a treatment group for a particular character are no significant statistically at 5 percent probability.

4.17.2. Apical shoot length in fresh cutting experiment at 5 WAP

The effect of rooting media, varieties and their interactions on apical shoot length in fresh cuttings 5 WAP is shown in table 4.17.2.

The response due to propagating media and varieties were highly significant. When the rooting media means were critically examined, it was observed that PMIII gave significantly longer apical shoots than all other media under trial which constituted a non significant group. Among varieties, Anab x American gave significantly longer apical shoot than all other varieties tested. This was viz by Black hamburgh and Queen golden. The length of the apical shoot produced by these two varieties is at par with those produced by Anab-e-shahi, Bangalore blue, Catawaba, MKM-7 and Regina.

Interaction between rooting media and varieties was also highly significant. When the same medium was considered viz-a-viz the varieties, there was no differential response in all the media tested except in PMIII and sand. When the same variety was compared in relation to different media, the varieties Anab x American, Bangalore blue and Catawaba responded differentially to different rooting media. Longer apical shoots were obtained in rooting media x varietal combination of Anab x American hybrid in PMIII and sand.

4.17.3. Apical shoot length in fresh cutting experiment at 8 WAP

The effect of rooting media, varieties and their interactions on apical shoot length in fresh cuttings 8 WAP is shown in table 4.17.3.

Table 4.17.2 Effect of rooting medium x variety on apical shoot length (cm) at 5WAP in fresh cutting experiment during 1992 dry season

	Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	Sawdust	Rice-hull	Component percent: Top Soil F.Y.M. Sand	37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0	Means SE± 0.60
1.	Anab-e-Shahi	2.33ef	4.33c-f	1.58f	1.00f		1.03f	2.33ef	1.63f	2.04b-d
2.	Anab x Amer Sed.	5.58c-f	12.80ab	4.87c-f	1.83f		5.53c-f	1.10f	16.92a	6.66a
3.	Bang. Blue	3.75c-f	1.63f	2.75d-f	1.08f		2.63d-f	2.32ef	7.75b-e	3.13bc
4.	Bl. Hambourg	3.85c-f	3.67c-f	4.47c-f	1.50f		5.77c-f	1.00f	6.37c-f	3.80b
5.	Cardinal	1.08f	1.00f	1.00f	1.00f		2.15ef	1.00f	1.00f	1.18cd
6.	Catawaba	2.62d-f	3.25c-f	3.17c-f	1.08f		1.30f	1.00f	8.43b-d	2.98b-d
7.	Ex-Zaria Bl.	1.50f	1.42f	2.27ef	1.00f		1.85f	1.25f	2.28ef	1.65cd
8.	MKM-7	2.10ef	1.00f	3.00c-f	2.83d-f		2.12ef	1.00f	3.75c-f	2.27b-d
9.	Regina	1.00f	4.30c-f	1.58f	2.75d-f		1.03f	1.00f	1.42f	1.87b-d
10.	Thm. Seedless	1.00f	1.00f	1.08f	1.00f		1.00f	1.00f	1.00f	1.01d
11.	Queen Golden	1.95ef	1.83f	6.75c-f	2.58ef		1.42f	2.42ef	8.77bc	3.67b
	Interaction SE± 1.61									
	Mean	2.25b	3.29b	2.96b	1.61b		2.35b	1.40b	5.39a	
	SE± 0.60									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.17.3 Effect of rooting medium x variety on apical shoot length (cm) at 8WAP in fresh cutting experiment during 1992 dry season

	Main Tr.	100 percent of				Component percent			
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil F.Y.M. Sand	37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0	Means SE± 0.77
1.	Anab-e-Shahi	1.50g	3.33e-g	1.13g	1.00g		2.83e-g	2.65e-g	2.50e-g	2.14de
2.	Anab x Amer Sed.	4.67d-g	16.17ab	6.07d-g	3.48e-g		5.82d-g	2.03fg	20.78a	8.43a
3.	Bang. Blue	5.45d-f	1.77fg	4.73d-g	1.67fg		3.03e-g	1.83fg	9.85b-e	4.05b-d
4.	Bl. Hambourg	4.32d-g	5.42d-g	5.00d-g	2.33e-g		5.13d-g	1.00g	9.23b-f	4.65b-d
5.	Cardinal	1.33g	1.00g	1.00g	1.00g		1.00g	1.00g	1.00g	1.05e
6.	Catawaba	3.35e-g	8.33c-g	5.83d-g	3.43e-g		1.35g	1.35g	11.67b-d	5.05bc
7.	Ex-Zaria Bl.	1.30g	1.00g	1.83fg	1.22g		2.17fg	1.00g	1.00g	1.36e
8.	MKM-7	2.25e-g	1.00g	5.17d-g	3.12e-g		1.67fg	1.08g	4.33d-g	2.66c-e
9.	Regina	1.83fg	6.22d-g	1.33g	2.83e-g		1.33g	1.00g	1.00g	2.22de
10.	Thm. Seedless	1.00g	1.00g	1.00g	1.00g		1.00g	1.00g	1.00g	1.00e
11.	Queen Golden	2.00fg	1.60fg	6.43d-g	8.22c-g		1.43g	3.28e-g	14.42a-d	5.34b
		Interaction SE± 2.11								
	Mean SE± 0.80	2.64bc	4.26b	3.59bc	2.66bc		2.43bc	1.57c	6.98a	

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

The response due to media and varieties were highly significant. When the rooting media means were closely examined, PMIII was observed to produce the longest apical shoots.

When varietal means were compared, Anab x American gave highest apical shoot length, this was viz by Queen golden, which produced statistically same apical shoot length as Catawaba, Black hamburgh and Bangalore blue which constituted a non significant group. The interaction between rooting media and varieties was highly significant. When different varieties were examined in the same media, differential responses were recorded in PMIII and sand. When the same variety was compared in relation to different media, the varieties Bangalore blue, Anab x American, Black hamburgh, Catawaba and Queen golden gave differential responses in different rooting substrates. Longer apical shoots were obtained in rooting media x varietal combination of Anab x American hybrid in PMIII and sand and Queen golden in PMIII.

4.17.4. Apical shoot length in fresh cutting experiment at 11 WAP

Table 4.17.4 shows the effect of rooting media, varieties and their interactions on apical shoot length in fresh cuttings, 11WAP. The effect due to media and varieties were highly significant. When the rooting media means compared, it was observed that PMIII gave higher apical shoot length than all other media under trial except sand.

Table 4.17.4 Effect of rooting medium x variety on apical shoot length (cm) at 11WAP in fresh cutting experiment during 1992 dry season

		100 percent of				Component percent				
	Main Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5	SE± 0.99
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.98ef	4.50d-f	1.00f	1.00f		6.67d-f	4.67d-f	6.97d-f	3.83b-d
2.	Anab x Amer Sad.	6.67d-f	18.58a-c	5.00d-f	6.57d-f		6.82d-f	2.35ef	23.20a	9.85a
3.	Bang. Blue	6.78d-f	2.60ef	8.00d-f	2.00ef		4.12d-f	3.17ef	13.27b-d	5.70b
4.	Bl. Hambourg	7.05d-f	8.77d-f	8.52d-f	5.28d-f		5.40d-f	1.00f	8.78d-f	6.40b
5.	Cardinal	1.75ef	1.00f	1.00f	2.33ef		4.83d-f	1.00f	1.00f	1.95d
6.	Catawaba	2.75ef	10.95c-e	6.28d-f	5.88d-f		1.57ef	1.00f	10.67c-f	5.59bc
7.	Ex-Zaria Bl.	2.53ef	2.33ef	1.83ef	1.00f		2.95ef	1.08f	1.00f	1.82d
8.	MKM-7	3.58d-f	3.17ef	7.32d-f	4.13d-f		3.43ef	1.00f	7.17d-f	4.26b-d
9.	Regina	1.67ef	5.90d-f	1.83ef	4.42d-f		1.00f	1.00f	1.00f	2.80cd
10.	Thm. Seedless	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.00d
11.	Queen Golden	1.53ef	3.18ef	5.50d-f	10.08c-f		1.00f	1.00f	20.90ab	6.17b
					Interaction SE± 2.67					
	Mean	3.39bc	5.63ab	4.30bc	3.97bc		3.53bc	1.66c	8.63a	
	SE± 0.9%									

Means followed by the same letter(s) within a treatment group for a particular character are no significant statistically at 5 percent probability.

When the varietal means were considered, Anab x American was found to produce longer apical shoots than all other varieties under trial.

The interaction between rooting media and varieties was also highly significant when same medium was considered with respect to differnt varieties, there was differential responses in PMIII and sand. When the same variety was critically examined in relation to different media, Anab x American hybrid and varieties Bangalore blue, Catawaba and Queen golden responded differentially to rooting media. Longer apical shoots were produced in rooting media x varietal combination of Anab x American. In PMIII and sand, Queen golden in PMIII which constituted a non significant group.

4.17.5. Apical shoot length in 3 weeks callused experiment at 2 W

Table 4.17.5 shows the effect of rooting media, varieties and their interactions on apical shoot length of 3 weeks callus cutting, 2 WAP.

The effect due to rooting media and varieties was significant at 5 and 1% levels respectively. When the media means were compared, grit was observed to yield longer apical shoot than all other substrates under trial except PMs II, III and sand.

Table 4.17.5 Effect of rooting medium x variety on apical shoot length (cm) at 2 weeks after planting in 3 weeks callused cutting trial during 1992 dry season.

		100 percent of				Component percent				
	Main Tr. / Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil / F.Y.M. / Sand	37.5 / 37.5 / 25.0	25.0 / 25.0 / 50.0	12.5 / 12.5 / 75.0	Means SE± 0.07
1.	Anab-e-Shahi	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	11.00b
2.	Anab x Amer Sed.	1.08d	1.20cd	1.08d	1.00d		1.08d	2.08a	1.08d	1.23ab
3.	Bang. Blue	1.07d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	0.01b
4.	Bl. Hambourg	1.00d	1.33b-d	1.00d	1.00d		1.10d	1.00d	1.78a-c	1.17ab
5.	Cardinal	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00b
6.	Catawaba	2.08a	1.13d	1.00d	1.00d		1.00d	1.00d	1.00d	1.17ab
7.	Ex-Zaria Bl.	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00b
8.	MKM-7	1.58a-d	1.08d	1.03d	1.05d		1.00d	1.90ab	1.33b-d	1.28a
9.	Regina	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00b
10.	Thm. Seedless	1.00d	1.00d	1.05d	1.00d		1.00d	1.00d	1.00d	1.01b
11.	Queen Golden	1.23cd	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.05d
	Interaction SE± 0.18									
	Mean	1.19a	1.07a-c	1.02bc	1.01c		1.02bc	1.18ab	1.11a-c	
	SE± 0.05									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Among varieties, MKM-7 gave longer apical shoots than all other varieties tested except Anab x American seedling, Black hamburgh, Catawaba and Queen golden. The interactions between rooting media and varieties was highly significant. When the same medium was compared in relation to the different varieties used for the experiment, differential responses were recorded for PMII, III and grit. When the same variety was studied in relation to different media Anab x American hybrid, Bangalore blue, Catawaba, and MKM-7 exhibited differential responses to rooting media. Longer basal shoots were recorded for rooting media x varietal combination of Anab x American in PMII, Catawaba in grit, MKM-7 in PMII, Black hamburgh in PMIII and MKM-7 in grit in that order and which constituted a non significant group.

4.17.6. Apical shoot length in 3 weeks callused experiment at 5 W

The effect of rooting media, varieties and their interactions on apical shoot length of 3 weeks callus cutting 5WAP is shown in table 4.17.6.

The response due to rooting media and varieties were found to be highly significant. When the media means were statistically analysed, PMIII, grit and sand were observed to produce longer apical shoots than all other media under trial which constituted another non-significant group.

When varietal means were critically examined, Anab x American and Catawaba gave significantly longer apical

Table 4.17.6 Effect of rooting medium x variety on apical shoot length (cm) at 5WAP in 3 weeks callused cutting experiment during 1992 dry season.

		100 percent of				Component percent				
	Main Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5	SE± 0.21
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00b
2.	Anab x Amer Sed.	2.21cd	2.48b-d	1.43d	1.35d		1.08d	1.53d	4.25ab	2.06a
3.	Bang. Blue	1.37d	1.00d	1.00d	1.00d		1.00d	1.00d	1.78cd	1.16b
4.	Bl. Hambourg	1.15d	1.17d	1.00d	1.00d		1.97cd	1.07d	3.73a-c	1.58ab
5.	Cardinal	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00b
6.	Catawaba	4.75a	4.75a	2.93a-d	1.40d		1.00d	1.00d	1.00d	1.87a
7.	Ex-Zaria Bl.	1.30d	1.00d	1.00d	1.00d		1.00d	1.00d	1.35d	1.10b
8.	MKM-7	1.63d	2.77a-d	1.37d	1.63d		1.00d	1.90cd	1.63d	1.66ab
9.	Regina	1.00d	1.07d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00b
10.	Thm. Seedless	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00b
11.	Queen Golden	1.22d	2.55b-d	1.32d	1.22d		1.00d	1.00d	1.00d	1.47ab
				Interaction SE± 0.55						
	Mean	1.67a	1.63a	1.14a	1.11b		1.10b	1.14b	1.71a	
	SE± 0.14									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

shoot than all other varieties under trial except MKM-7, Black hamburgh and Queen golden. The interactions between rooting media and varieties was also highly significant. When same medium was considered in respect to different varieties, there were differential responses in PMIII and grit. When the same variety was studied in relation to different media, the hybrid Anab x American and the varieties Black hamburgh and Catawaba responded differently to rooting media. Longer apical shoots were obtained from rooting media x varietal combination of Catawaba in grit and sand, Anab x American hybrid and Black hamburgh in PMIII, and MKM-7 in sand.

4.17.7. Apical shoot length in 3 weeks callused experiment at 8 WAP

The effect of rooting media, varieties and their interactions on apical shoot length of 3 weeks callus cutting, 8WAP is shown in table 4.17.7.

The response of rooting media and varieties was significant at 5 and 1% levels respectively. When the rooting substrate means were critically studied, sand and grit were observed to result in longer apical shoots than all other substrates under trial except PMIII and ricehull.

Among varieties, Anab x American seedling and Catawaba were found to give longer apical shoots than all others except Black hamburgh and Queen golden. The interaction between rooting media and varieties was highly significant.

Table 4.17.7 Effect of rooting medium x variety on apical shoot length (cm) at 8WAP in 3 weeks callused cutting experiment during 1992 dry season.

	Main Tr.	100 percent of				Component percent				
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil F.Y.M. Sand	37.5 37.5 25.0	25.0 25.0 50.0	12.5 12.5 75.0	Means SE± 0.35
1.	Anab-e-Shahi	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00d
2.	Anab x Amer Sed.	3.45a-d	4.97ab	2.83a-d	2.23a-d		1.30cd	2.93a-d	4.50a-c	3.17a
3.	Bang. Blue	2.02a-d	1.00d	1.88a-d	1.30cd		1.00d	1.00d	2.03a-d	1.46cd
4.	Bl. Hambourg	2.85a-d	5.08a	1.00a	1.85a-d		2.33a-d	1.67b-d	3.68a-d	2.64ab
5.	Cardinal	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00d
6.	Catawaba	5.32a	4.45a-c	1.83a-d	4.37a-d		1.42cd	1.33cd	1.20cd	3.13a
7.	Ex-Zaria Bl.	1.00d	1.50d	1.00d	1.00d		1.00d	1.00d	1.08d	1.08d
8.	MKM-7	1.58cd	2.50a-d	2.08a-d	2.17a-d		1.00d	2.50a-d	1.75a-d	1.94b-d
9.	Regina	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00d
10.	Thm. Seedless	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00d
11.	Queen Golden	3.90a-d	3.52a-d	1.43cd	3.85a-d		1.00d	1.00d	1.00d	2.24a-c
					Interaction SE± 0.93					
	Mean SE± 0.27	2.37a	2.46a	1.46b	1.89ab		1.19b	1.40b	1.75ab	

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

When the same rooting substrate was considered in respect to different varieties, there were differential responses in PMIII, sand and grit. When the same variety was considered in different media, the varieties Anab x American, Black hamburgh and Catawaba exhibited differential responses to rooting media. Longer apical shoots were recorded in substrate x varietal combinations of Catawaba in all the media tested except the three potting mixtures,
Anab x American in all the media under trial except PMI, Bangalore blue in PMIII, sawdust and grit, Black hamburgh and PMII, MKM-7 in all media except PMI and grit, and Queen golden in ricehull, sand and grit.

4.17.8. Apical shoot length in 3 weeks callused experiment at 11 WAP

Table 4.17.8 shows the effect of rooting media, varieties and their interactions on apical shoot length of 3 weeks callus cuttings, 11WAP.

The response due to media and varieties was significant at 5 and 1% levels respectively. When the rooting substrate means were compared, it was observed that grit resulted in significantly longer apical shoots than all other media tested excep ricehull, sand and pmIII.

Among varieties, Anab x American gave longer apical shoots than all other varieties under trial except Catawaba. The interactions between rooting media and varieties was highly significant. When the same medium was studied in

Table 4.17.8 Effect of rooting medium x variety on apical shoot length (cm) at 11WAP in 3 weeks callused cutting experiment during 1992 dry season.

		100 percent of				Component percent				
	Main Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5	SE± 0.42
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.00e
2.	Anab x Amer Sed.	6.50a-d	7.02a-c	4.50a-f	3.22c-f		1.00f	3.33c-f	4.50a-f	4.30a
3.	Bang. Blue	4.03a-f	1.00f	1.00f	1.40f		2.37ef	1.00f	2.43ef	1.99c-e
4.	Bl. Hambourg	3.17c-f	2.97c-f	1.00f	2.25ef		1.00f	2.25ef	4.13a-f	2.80b-d
5.	Cardinal	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.00e
6.	Catawaba	7.45ab	4.15a-f	2.17ef	5.47a-e		1.42d-f	1.75d-f	1.00f	3.54ab
7.	Ex-Zaria Bl.	1.00f	1.00f	1.00f	1.00f		1.00f	1.17f	1.00f	1.02d
8.	MKM-7	1.35f	1.00f	2.27ef	2.20ef		1.00f	2.77d-f	1.00f	1.65c-e
9.	Regina	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.00e
10.	Thm. Seedless	1.00f	1.00f	1.00f	1.00f		1.00f	1.00f	1.00f	1.00e
11.	Queen Golden	3.97b-f	3.08c-f	1.47ef	8.08a		1.00f	1.00f	1.00f	2.80bc
					Interaction SE± 1.12					
	Mean	2.86a	2.30a-c	1.68bc	2.51ab		1.16c	1.57bc	1.77a-c	
	SE± 0.36									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

respect to the different varieties, there were differetial responses in ricehull, sand and grit. When the same variety was considered in relation to different media, the varieties Anab x American, Catawaba and Queen golden responded differentially to rooting media. Longer apical shoots were produced in a rooting media x varietal combination of Queen golden in ricehull, Anab x American in all the media tested except PMI, II and ricehull, Bangalore in grit, Black hamburgh in PMIII and Catawaba in grit, sand and rice-hull.

4.17.9. Apical shoot length in 6 weeks callused experiment at 2 WAP

Table 4.17.9 shows the effect of rooting media, varieties and their interactions on apical shoot length of 6 weeks callus cuttings, 2WAP.

The response due to media was not significant, however that due to varieties was significant at 5% level. When the vartietal means were considered, Anab x American and Catawaba were found to be at par and gave significantly longer apical shoot than all other varieties under trial which formed a non significant group.

The interaction between rooting media and varieties was found to be highly significant. When the different varieties were tested in the same propagating medium, the three potting mixtures were found to show differential responses. While

Table 4.17.9 Effect of rooting medium x variety on apical shoot length (cm) at 2WAP in 3 weeks callused cutting experiment during 1992 dry season.

		100 percent of				Component percent				
	Main Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5	SE± 0.07
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00b
2.	Anab x Amer Sad.	1.00c	1.00c	1.00c	1.00c		1.00c	1.17c	1.92ab	1.55a
3.	Bang. Blue	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00b
4.	Bl. Hambourg	1.00c	1.00c	1.00c	1.00c		1.37bc	1.18c	1.00c	1.08b
5.	Cardinal	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00b
6.	Catawaba	1.00c	1.00c	1.00c	1.00c		2.40a	1.87ab	1.00c	1.32a
7.	Ex-Zaria Bl.	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00b
8.	MKM-7	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00b
9.	Regina	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00b
10.	Thm. Seedless	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00b
11.	Queen Golden	1.00c	1.00c	1.00c	1.00c		1.25bc	1.00c	1.00c	1.04b
					Interaction SE± 0.19					
	Mean	1.00	1.00	1.00	1.00		1.18	1.11	1.08	
	SE± 0.06									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

when the same variety was compared in relation to different media, the varieties Anab x American and Catawaba responded differentially to rooting media. Longer apical shoots resulted from the rooting media x varietal combination of Catawaba in PMI and II and Anab x American in PMIII.

4.17.10. Apical shoot length in 6 weeks callused experiment at 5 WAP

The response of rooting media, varieties and their interactions on apical shoot length production in 6 weeks callus cutting, 5WAP is shown in table 4.17.10.

The effect of media and varieties were found to be highly significant. When the rooting media means were compared, it was observed that PMI gave significantly longer apical shoot than all other media tested with the exception of PMII and III.

Among varieties, Anab x American produced longer apical shoots than all other varieties under trials except MKM-7, Black hamburgh and Catawaba. The interaction between rooting media and varieties was also highly significant. When different varieties were examined in the same medium, there was no differential response. In all except the three potting mixtures. When the same variety was studied in relation to different media, the hybrid, Anab x American and the varieties Black hamburgh, Catawaba and MKM-7 responded differentially to different rooting media. Longer apical shoots were obtained from the rooting media and varietal

Table 4.17.10 Effect of rooting medium x variety on apical shoot length (cm) at 5WAP in 6 weeks callused cutting experiment during 1992 dry season.

		100 percent of				Component percent				
	Main Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5	SE± 0.15
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00c
2.	Anab x Amer Sed.	1.58c-e	1.93a-e	1.00e	1.00e		1.67b-e	2.62a-e	3.27a	1.87a
3.	Bang. Blue	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00c
4.	Bl. Hambourg	1.00e	1.05e	1.00e	1.00e		2.20a-e	2.68a-d	1.05e	1.49a-c
5.	Cardinal	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00c
6.	Catawaba	1.00e	1.00e	1.00e	1.00e		3.10ab	2.03a-e	1.00e	1.45a-c
7.	Ex-Zaria Bl.	1.00e	1.00e	1.00e	1.27de		1.00e	1.43c-e	1.00e	1.10c
8.	MKM-7	1.39c-e	2.00a-e	1.00e	1.00e		2.13a-e	1.00e	2.73a-c	1.61ab
9.	Regina	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00c
10.	Thm. Seedless	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00c
11.	Queen Golden	1.00e	1.00e	1.00e	1.00e		1.92a-e	1.00e	1.00e	1.13bc
					Interaction SE± 0.40					
	Means	1.09cd	1.22b-d	1.00d	1.02d		1.55a	1.43ab	1.37a-c	
	SE± 0.09									

Means followed by the same letter(s) within a treatment group for a particular character are no significant statistically at 5 percent probability.

combination of Anab x American in PMIII, II and sand, Catawaba and Black hamburgh in PMI and II, MKM-7 in PMs III, I and sand and Queen golden in PMI.

4.17.11. Apical shoot length in 6 weeks callused experiment at 11 WAP

The effect of rooting media, varieties and their interactions on apical shoot length production by 6 weeks callus cuttings, 11 WAP is shown in table 4.17.11

The response due to media and varieties was significant at 5 and 1% levels respectively. When the media means were compared, it was observed that PMI gave significantly higher apical shoot length than all other media under trial except the other two potting mixtures and grit.

Among varieties, Anab x American produced apical shoot length which was at par with those of Catawaba and MKM-7. The interaction between rooting media and varieties was highly significant. When the same rooting media was considered in respect to different varieties, there was differential response in all rooting media except sawdust, sand ricehull, when the same variety was considered in relation to different media, the varieties Anab-e-shahi, Anab x American and MKM-7 in PMIII and II, Anab x American in PMI and II and Anab-e-shahi in grit.

4.18. Basal shoot length

4.18.1 Basal shoot length in fresh cutting experiment at 2 WAP

Table 4.18.1 shows the effect of rooting media, varieties and their interactions on basal shoot length of fresh cuttings 2 WAP.

Table 4.17.11 Effect of rooting medium x variety on apical shoot length (cm) at 11WAP in 6 weeks callused cutting experiment during 1992 dry season.

	Main Tr.	100 percent of				Component percent				
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
						F.Y.M.	37.5	25.0	12.5	SE± 0.25
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	4.30a-c	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00c
2.	Anab x Amer Sed.	1.08e	1.25de	1.00e	1.00e		4.43ab	3.62a-d	2.00c-e	2.61a
3.	Bang. Blue	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.09c
4.	Bl. Hambourg	1.00e	1.00e	1.00e	1.00e		1.42de	3.18b-e	1.00e	1.60bc
5.	Cardinal	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00c
6.	Catawaba	2.60b-e	3.08b-e	1.00e	1.00e		1.00e	1.42de	1.00e	2.21ab
7.	Ex-Zaria Bl.	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.23c
8.	MKM-7	1.00e	1.00e	1.00e	1.00e		1.00e	3.87a-c	5.95a	2.21ab
9.	Regina	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00c
10.	Thm. Seedless	1.00e	1.00e	1.00e	1.00e		1.00e	1.00e	1.00e	1.00c
11.	Queen Golden	1.00e	1.00e	1.00e	1.00e		1.00e	1.30de	1.00e	1.05c
					Interaction SE± 0.67					
	Means	1.55a-c	1.27bc	1.00c	1.00c		1.84a	1.65a-c	1.74ab	
	SE± 0.21									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.18.1 Effect of rooting medium x variety on basal shoot length (cm) at 2WAP in fresh cutting experiment during 1992 dry season.

	Main Tr.	100 percent of				Component percent				
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
						F.Y.M.	37.5	25.0	12.5	SE± 0.23
						Sand	75.0	50.0	75.0	
1.	Anab-e-Shahi	1.33j	2.67d-j	1.50hi	1.00j		2.17f-j	2.00f-j	2.08fj	1.82c-e
2.	Anab x Amer Sed.	3.58b-h	5.67ab	4.67a-d	2.33e-j		2.83d-j	1.00j	6.83a	3.85a
3.	Bang. Blue	2.75d-j	1.17ij	2.50d-j	1.17ij		2.33e-j	1.83g-j	2.67d-j	2.06b-d
4.	Bl. Hambourg	3.00c-j	4.08b-f	3.58b-h	2.22f-j		1.67h-j	1.00j	4.08b-f	2.81b
5.	Cardinal	1.25ij	1.00j	1.00j	1.00j		2.17f-j	1.00j	1.00j	1.20ef
6.	Catawaba	1.67h-j	2.88c-j	2.92c-j	1.92f-i		1.17ij	1.00i	2.50d-j	2.01c-e
7.	Ex-Zaria Bl.	1.33ij	1.42h-j	1.17ij	1.00j		1.25ij	1.08j	1.00j	1.17ef
8.	MKM-7	2.72d-j	1.00j	4.50b-e	2.00f-j		1.00j	1.00j	1.4.00b-g	2.32bc
9.	Regina	1.00j	3.33c-j	1.33ij	1.00j		1.00j	1.00j	1.00j	1.38d-f
10.	Thm. Seedless	1.00j	1.00j	1.00j	1.00j		1.00j	1.00j	1.00j	1.00f
11.	Queen Golden	1.33ij	2.03f-j	1.50h-j	2.00f-j		2.00f-j	1.00i	5.08a-c	2.14b-d
					Interaction SE± 0.62					
	Means	1.91bc	2.39ab	2.33ab	1.51cd		1.69b-d	1.17d	2.84a	
	SE± 0.22									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

The response due to media and varieties was highly significant. When the rooting media means were objectively studied, it was observed that PMIII gave higher basal shoot length than all other media tested except sand and sawdust.

Among varieties, Anab x American hybrid gave significantly longer basal shoots than all other varieties. The interactions between propagating media and varieties was highly significant. When the different varieties were critically examined in the same medium, there was differential responses in all the rooting media except PMI, II and ricehull. When the same variety was considered in relation to different media, Anab x American hybrid, Black hamburgh, MKM-7 and Queen golden responded differentially to rooting media. Longer basal shoots were produced in a rooting media x varietal combination of Anab x American in PMIII, sand and sawdust, and Queen golden in PMIII.

4.18.2. Basal shoot length in fresh cutting experiment at 5 WAP

The effect of rooting media varieties and their interaction on basal shoot length in fresh cuttings 5WAP is shown in table 4.18.2

Neither rooting media nor varietal means were found to be significant. The interaction between rooting media and varieties was also not statistically significant.

Table 4.18.2 Effect of rooting medium x variety on basal shoot length (cm) at 5WAP in fresh cutting experiment during 1992 dry season.

	Main Tr.	100 percent of				Component percent				
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
						F.Y.M.	37.5	25.0	12.5	SE± 0.22
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.00	2.17	2.92	2.00		1.00	1.00	1.17	1.67
2.	Anab x Amer Sed.	2.83	2.83	3.08	3.08		1.00	1.05	1.17	2.04
3.	Bang. Blue	1.08	1.25	1.00	1.08		1.53	1.00	1.00	1.15
4.	Bl. Hambourg	1.00	2.38	1.08	1.00		1.00	1.00	1.00	1.24
5.	Cardinal	1.00	1.00	1.00	1.00		1.30	1.00	1.00	1.04
6.	Catawaba	1.00	1.17	1.58	1.08		1.00	1.00	3.08	1.42
7.	Ex-Zaria Bl.	1.08	2.25	1.33	1.00		2.08	1.00	2.17	1.56
8.	MKM-7	1.00	1.10	1.08	1.00		1.00	1.92	1.00	1.16
9.	Regina	1.08	1.93	1.08	1.00		1.08	1.00	2.50	1.38
10.	Thm. Seedless	1.00	1.00	1.08	1.00		1.00	1.00	1.00	1.01
11.	Queen Golden	1.00	1.00	1.08	2.42		1.00	2.83	1.00	1.48
					Interaction SE± 0.59					
	Means	1.16	1.64	1.49	1.40		1.18	1.26	1.46	
	SE± 0.18									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

4.18.3. Basal shoot length in fresh cutting experiment at 8 WAP

The effect of rooting mediair interactions on basal shoot length of fresh cuttings, 8WAP is shown in table 4.18.3.

The effect due to rooting media and varieties were both not significant. The interactions between rooting media and varieties was highly significant. When different varieties were examined in the same propagating medium, there was differential response in ricehull, PMII and III. On considering the same variety in different media,

Anab x Americn, Bangalore blue and Queen golden responded differentially to the different media. Longer basal shoot per cutting was recorded for the rooting media x varietal combination of Bangalore blue in PMIII, Queen golden in PMII, Anab x American in ricehull, Catawaba in PMIII and

Anab x American hybrid in sawdust in that order.

4.18.4. Basal shoot length in fresh cutting experiment at 11 WAP

The effect of rooting media, varieties and their interactions on basal shoot length of fresh cuttings, 11 WAP is shown in table 4.18.4.

The response due to media and varieties were not significant. The interactions between rooting media and varieties was however highly significant. When same medium was considered viz-a-viz the different varieties, there was differential response in PMIII, rice-hull and sawdust. When

Table 4.18.3 Effect of rooting medium x variety on basal shoot length (cm) at 8WAP in fresh cutting experiment during 1992 dry season.

	Main Tr.	100 percent of				Component percent				
	Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
						F.Y.M.	37.5	25.0	12.5	SE± 0.36
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.00d	1.87b-d	2.75b-d	2.33b-d		1.00d	1.00d	1.00d	1.56
2.	Anab x Amer Sed.	2.33b-d	3.12b-d	4.07a-d	4.60a-c		1.00d	1.00d	1.00d	2.45
3.	Bang. Blue	2.83b-d	1.08d	1.33cd	1.33cd		1.32cd	1.00d	6.97a	2.27
4.	Bl. Hambourg	1.33cd	3.18b-d	1.10d	1.00d		1.08d	1.00d	3.00b-d	1.67
5.	Cardinal	1.00d	1.00d	1.00d	1.00d		1.17d	1.00d	1.00d	1.02
6.	Catawaba	1.00d	1.92b-d	1.98b-d	1.00d		1.00d	1.00d	4.08a-d	1.71
7.	Ex-Zaria Bl.	1.38cd	1.00d	1.37cd	1.00d		2.35b-d	1.00d	2.00b-d	1.74
8.	MKM-7	1.00d	1.13d	1.50cd	1.15d		1.33cd	1.00d	1.00d	1.16
9.	Regina	1.00d	2.27b-d	1.00d	1.00d		1.00d	1.00d	1.00d	1.18
10.	Thm. Seedless	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00
11.	Queen Golden	1.00d	1.00d	1.13d	2.67b-d		1.00d	4.95ab	1.00d	1.82
					Interaction SE± 0.94					
	Means	1.35	1.69	1.66	1.64		1.20	1.36	2.10	
	SE± 0.29									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Table 4.18.4 Effect of rooting medium x variety on basal shoot length (cm) at 11WAP in fresh cutting experiment during 1992 dry season.

		100 percent of				Component percent			
	Main Tr. / Sub. Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil / F.Y.M. / Sand	37.5 / 37.5 / 25.0	25.0 / 25.0 / 50.0	12.5 / 12.5 / 75.0	Means SE± 0.41
1.	Anab-e-Shahi	1.00d	2.00b-d	3.17b-d	1.00d		2.50b-d	1.00d	1.00d	1.61
2.	Anab x Amer Sed.	1.03d	2.93b-d	5.07a-c	5.70ab		1.00d	1.00d	2.00b-d	2.67
3.	Bang. Blue	1.25cd	1.50cd	1.00d	1.00d		3.67b-d	1.00d	7.80a	2.46
4.	Bl. Hambourg	1.50cd	3.00b-d	1.35cd	1.17d		1.00d	1.00d	3.75b-d	1.82
5.	Cardinal	1.33cd	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.05
6.	Catawaba	1.00d	1.70cd	2.10b-d	1.00d		1.00d	1.10d	4.50a-d	1.77
7.	Ex-Zaria Bl.	1.75cd	1.83b-d	1.67cd	1.25cd		2.67b-d	1.00d	1.00d	1.63
8.	MKM-7	1.00d	1.33cd	1.58cd	1.33cd		4.17a-d	1.00d	1.33cd	1.68
9.	Regina	1.00d	2.67b-d	1.00d	1.00d		1.00d	1.00d	1.00d	1.24
10.	Thm. Seedless	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00
11.	Queen Golden	1.00d	1.00d	1.22cd	3.35b-d		1.00d	1.00d	1.00d	1.97
				Interaction SE± 1.07						
	Means	1.27	1.81	1.85	1.71		1.82	1.61	2.31	
	SE± 0.31									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

the same variety was considered in relation to different media, Anab x American hybrid and Bangalore blue responded differently to rooting media. Longer basal shoot were produced in rooting media x varietal combinations of Bangalore blue in PMIII which was statistically same as Anab x American in rice-hull and sawdust, Catawaba in PMIII and MKM-7 in PMI in that order.

4.18.5. Basal shoot length in 3 weeks callused experiment at 5 WAP

The effect of rooting media, varieties and their interactions on basal shoot length of 3 weeks callus cuttings, 5WAP is shown in table 4.18.5.

The effect due to media and varieties was significant at 5 and 1% levels respectivaly. When the substrate means were compared, it was observed that grit resulted in longer basal shoots than the three potting mixtures and was at par with sand, sawdust and ricehull, the latter three with the three potting mixtures constituted a non significant group.

Among varieties, Catawaba gave significantly same basal shoot length as MKM-7, Anab x American hybrid, Black hamburgh, Bangalore blue and Queen golden. The interaction between rooting media x varieties was highly significant. When the different varieties were examined in the same rooting medium, the three potting mixtures, sand and rice-hull resulted in differential resposes. When the same

Table 4.18.5 Effect of rooting medium x variety on basal shoot length (cm) at 5WAP in 3 weeks calluseded cutting experiment during 1992 dry season.

		100 percent of				Component percent				
	Main Tr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
	Sub. Tr.					F.Y.M.	37.5	25.0	12.5	SE± 0.21
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00b
2.	Anab x Amer Sed.	2.57a-c	1.43bc	1.32bc	1.92a-c		1.10c	1.00c	1.35bc	1.53ab
3.	Bang. Blue	3.18ab	1.05c	1.00c	1.35bc		1.00c	1.00c	1.00c	1.37ab
4.	Bl. Hambourg	1.10c	2.60a-c	1.00c	1.35bc		1.40bc	1.22c	1.88bc	1.51ab
5.	Cardinal	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00b
6.	Catawaba	3.85a	2.17a-c	3.85a	1.00c		1.00c	1.00c	1.00c	2.00a
7.	Ex-Zaria Bl.	1.08c	1.00c	1.00c	1.22c		1.00c	1.00c	1.00c	1.04b
8.	MKM-7	2.43a-c	1.30bc	1.87bc	1.12c		1.00c	1.00c	2.20a-c	1.56ab
9.	Regina	1.00c	1.05c	1.00c	1.00c		1.00c	1.00c	1.00c	1.01b
10.	Thm. Seedless	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00b
11.	Queen Golden	1.53bc	1.00c	1.37bc	2.40a-c		1.00c	1.00c	1.00c	1.33ab
				Interaction SE± 0.54						
	Means	1.80a	1.33ab	1.40ab	1.31ab		1.05b	1.02b	1.22b	
	SE± 0.16									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

varietiey was studied in relation to different media, the varieties, Bangalore blue and Catawaba showed differential responses to rooting media. Longer basal shoots were recorded in rooting media x varietal combination of Catawaba in grit, sawdust and sand, Anab x American seedling in grit and ricehull, Bangalore blue in grit, Black hamburgh in sand, MKM-7 in grit and PMIII and Queen golden in rice-hull.

4.18.6. Basal shoot length in 6 weeks calluseded experiment at 2 WAP

Table 4.18.6 shows the effect of rooting media, varieties and their interactions on basal shoot length production in 6 weeks callus cuttings 2WAP.

The effects due to rooting media and varieties were both not significant. The interaction between rooting media and varieties was highly significant. When the same medium was considered viz-a-viz the different varieties there was no differential response in all except PMI and III. When the same variety was examined in different media, the varieties Anab x American, and MKM-7 showed differential responses to rooting media. Longer basal shoots resulted from the rooting media x varietal combination of MKM-7 in PMIII and Anab x American in PMI.

Table 4.18.6 Effect of rooting medium x variety on basal shoot length (cm) at 2WAP in 6 weeks calluseded cutting experiment during 1992 dry season.

	Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	Sawdust	Rice-hull	Component percent: Top Soil / F.Y.M. / Sand	37.5 / 37.5 / 25.0	25.0 / 25.0 / 50.0	12.5 / 12.5 / 75.0	Means SE± 0.12
1.	Anab-e-Shahi	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00
2.	Anab x Amer Sed.	1.00c	1.00c	1.00c	1.00c		2.28ab	1.00c	1.00c	1.18
3.	Bang. Blue	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00
4.	Bl. Hambourg	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00
5.	Cardinal	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00
6.	Catawaba	1.00c	1.00c	1.00c	1.00c		2.00bc	1.00c	1.00c	1.14
7.	Ex-Zaria Bl.	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.04
8.	MKM-7	1.00c	1.00c	1.00c	1.00c		1.00c	2.00bc	3.33a	1.49
9.	Regina	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00
10.	Thm. Seedless	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00
11.	Queen Golden	1.00c	1.00c	1.00c	1.00c		1.00c	1.00c	1.00c	1.00
				Interaction SE± 0.33						
	Means	1.04	1.00	1.00	1.00		1.21	1.09	1.21	
	SE± 0.10									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

4.18.7. Basal shoot length in 6 weeks calluseded experiment at 8 WAP

The effect of rooting media, varieties and their interactions on basal shoot length in 6 weeks callus cuttings 8WAP is shown in table 4.18.7.

The response due to media and varieties was not significant and highly significant respectively. When the varieties were considered, Catawaba was found to produce significantly longer basal shoot than all other varieties under trial except Anab x American hybrid and MKM-7.

The interaction between rooting media and varieties was found to be highly significant. When the same media was studied in respect of different varieties, there was no differential response in all the media except PMIII. When the same variety was analysed in relation to different media, only the variety MKM-7 responded differentially to different rooting media x varietal combinations of MKM-7 in PMIII, Anab x American in PMI and grit, Anab-e-shahi in grit and Catawaba in grit, sand and PMI which constituted a non significant group.

Table 4.18.7 Effect of rooting medium x variety on basal shoot length (cm) at 8WAP in 6 weeks calluseded cutting experiment during 1992 dry season.

	Main Tr. / Sub. Tr.	100 percent of: Grit	Sand	Sawdust	Rice-hull	Component percent: Top Soil / F.Y.M. / Sand	37.5 / 37.5 / 25.0	25.0 / 25.0 / 50.0	12.5 / 12.5 / 75.0	Means SE± 0.25
1.	Anab-e-Shahi	3.70ab	1.00b	1.00b	1.00b		1.00b	1.00b	1.00b	1.40bc
2.	Anab x Amar Sad.	2.50ab	1.13b	1.00b	1.00b		3.78ab	1.98b	1.87b	1.90ab
3.	Bang. Blue	1.00b	1.00b	1.00b	1.00b		1.00b	1.00b	1.00b	1.00c
4.	Bl. Hambourg	1.00b	1.00b	1.00b	1.00b		1.37b	1.70b	1.30b	1.20bc
5.	Cardinal	1.00b	1.00b	1.00b	1.00b		1.00b	1.00b	1.00b	1.00c
6.	Catawaba	3.97ab	3.07ab	1.00b	1.00b		3.50ab	1.30b	1.97b	2.26a
7.	Ex-Zaria Bl.	1.00b	1.00b	1.00b	1.00b		1.00b	1.00b	1.00b	1.00c
8.	MKM-7	1.00b	1.00b	1.00b	1.00b		1.00b	1.00b	5.68a	1.67a-c
9.	Regina	1.00b	1.00b	1.00b	1.00b		1.00b	1.00b	1.00b	1.00c
10.	Thm. Seedless	1.00b	1.00b	1.00b	1.00b		1.00b	1.00b	1.00b	1.00c
11.	Queen Golden	1.00b	1.00b	1.00b	1.00b		1.00b	1.00b	1.00b	1.00c
					Interaction SE± 0.94					
	Means	1.66	1.20	1.00	1.00		1.51	1.38	1.62	
	SE± 0.22									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

4.18.8. Basal shoot length in 6 weeks callused experiment at 11 WAP

Table 4.18.8 shows the effect of rooting media, varieties and their interactions on basal shoot length of 6 weeks callus cuttings, 11 WAP.

The response due to rooting media and varieties was not significant and significant at 5% level respectively. When the varieties were studied closely, the variety MKM-7 and Anab x American hybrid gave significantly higher basal shoot length than all other varieties under trial except Catawaba, Anab-e-shahi and Black hamburgh.

The interaction between rooting media and varieties was found to be highly significant. When the same medium was considered in respect to different varieties, there were no differential response in sand, sawdust and ricehull. When the same variety was examined in relation to different media, the varieties Anab-e-shahi, Anab x American, and MKM-7 responsed differentially to propagating media. Longer basal shoots were obtained in rooting media x varietal combination of MKM-7 in PMIII and II, Anab x American in PMI and II, Anab in grit and Black hamburgh in PMII.

Table 4.18.8 Effect of rooting medium x variety on basal shoot length (cm) at 11WAP in 6 weeks callused cutting experiment during 1992 dry season.

	Main fr.	100 percent of				Component percent				
	Sub. fr.	Grit	Sand	Sawdust	Rice-hull	Top Soil	37.5	25.0	12.5	Means
						F.Y.M.	37.5	25.0	12.5	SE± 0.29
						Sand	25.0	50.0	75.0	
1.	Anab-e-Shahi	4.30ab	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.47ab
2.	Anab x Amer Sed.	1.08cd	1.25cd	1.00d	1.00d		4.43ab	3.62a-d	2.00b-d	2.06a
3.	Bang. Blue	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00b
4.	Bl. Hambourg	1.00d	1.00d	1.00d	1.00d		1.42cd	3.18a-d	1.00d	1.37ab
5.	Cardinal	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00b
6.	Catawaba	2.60b-d	3.08b-d	1.00d	1.00d		1.00d	1.42cd	1.00d	1.59ab
7.	Ex-Zaria Bl.	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00b
8.	MKM-7	1.00d	1.00d	1.00d	1.00d		1.00	3.87a-c	5.95a	2.12a
9.	Regina	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00b
10.	Thm. Seedless	1.00d	1.00d	1.00d	1.00d		1.00d	1.00d	1.00d	1.00b
11.	Queen Golden	1.00d	1.00d	1.00d	1.00d		1.00d	1.30cd	1.00d	1.04b
		Interaction SE± 0.77								
	Means	1.45	1.21	1.00	1.00		1.35	1.76	1.54	
	SE± 0.24									

Means followed by the same letter(s) within a treatment group for a particular character are not significant statistically at 5 percent probability.

Correlation studies

Simple correlation coefficient for fresh cutting experiment between root dry weight, root length, root volume and root number along with total leaf area, leaf dry weight and weight loss per cutting were worked out and the data presented in tables 4.19, 4.20, 4.21 for fresh, 3 and 6 weeks callused experiments respectively. In experiment with fresh cuttings, a critical analysis of the data revealed that root dry weight was significantly associated (at 5%) with root length, and the association was highly significant (at 1%) with all the other characters studied except weight loss per cutting which was positive but not significant statistically. When root length was studied, the association was positive and significant with root volume and highly significant with all other parameters studied including weight loss per cutting. When this relationship was considered with root volume, the association was again highly significant for all possible parameters except weight loss, where-in it was nagative and not significant. The association of root number was positive and highly significant with leaf area and leaf dry weight, and nagative and not significant with weight loss. The correlation of coefficient between leaf area and leaf dry weight was also positive and highly significant but it's association with weight loss was nagative and not

Table 4.19 Matrix of correlation coefficient between root dry weight and other vegetative parameters of grapevine as influenced by rooting medium and variety in experiment with fresh cuttings.

	Root dry weight (g)	Root length (cm)	Root volume (mls)	Number of roots	Total leaf area (mm^2)	Leaf dry weight (g)	Weight loss per cutting (g)
Root dry weight	1.000						
Root length	0.101*	1.000					
Root volume	0.480**	0.102	1.000				
Number of roots	0.370**	0.148**	0.751**	1.000			
Total leaf area	0.427**	0.097*	0.713**	0.662**	1.000		
Leaf dry weigth	0.413**	0.173**	0.692**	0.640**	0.787**	1.000	
Weight loss per cutting	0.019NS	0.124**	-0.045NS	-0.003NS	-0.040NS	0.037NS	1.000

NS = Not significant * = Significant at 5% level ** = Significant at 1% level

Table 4.20 Matrix of correlation coefficient between root dry weight and other vegetative parameters of grapevine as influenced by rooting medium and variety in 3 weeks callused experiment.

	Root dry weight (g)	Root length (cm)	Root volume (mls)	Number of roots	Total leaf area (mm^2)	Leaf dry weight (g)	Weight loss per cutting (g)
Root dry weight	1.000						
Root length	0.174*	1.000					
Root volume	0.678**	0.220**	1.000				
Number of roots	0.083NS	-.040NS	0.016NS	1.000			
Total leaf area	0.086NS	0.034NS	0.111*	0.013NS	1.000		
Leaf dry weigth	0.146**	0.107*	0.230**	0.016NS	0.271**	1.000	
Weight loss per cutting	0.012NS	-0.039NS	-0.010NS	0.542**	0.069NS	0.007NS	1.000

NS = Not significant * = Significant at 5% level ** = Significant at 1% level

Table 4.21 Matrix of correlation coefficient between root dry weight and other vegetative parameters of grapevine as influenced by rooting medium and variety in 6 weeks callused experiment.

	Root dry weight (g)	Root length (cm)	Root volume (mls)	Number of roots	Total leaf area (mm^2)	Leaf dry weight (g)	Weight loss per cutting (g)
Root dry weight	1.000						
Root length	0.095*	1.000					
Root volume	0.869**	0.060NS	1.000				
Number of roots	0.207**	0.041NS	0.148**	1.000			
Total leaf area	0.057NS	0.950**	0.039NS	0.015NS	1.000		
Leaf dry weigth	0.054NS	0.842**	0.046NS	-0.009NS	0.879**	1.000	
Weight loss per cutting	0.198**	0.108*	0.142**	0.758**	0.072NS	0.032NS	1.000

NS = Not significant * = Significant at 5% level ** = Significant at 1% level

significant. The coefficient of correlation between leaf dry weight and weight loss per cutting was found to be non significant, although the association was positive.

When the coefficient of correlation were critically analysed for the 3 weeks callus experiment, table 4.20, the correlation coefficient was found to be positive and highly significant between root dry weight and root length, root volume and leaf dry weight. And not significant for root number, leaf area and weight loss per cutting, although the association was positive. The relationship between root length and leaf dry weight was positive and significant, between root length and root volume, was also highly significant. The association between root length and leaf area was positive, weak and not significant. The coefficient of root lenth and root number, root length and weight loss per cutting were nagative and not significant. Root volume was significantly associated with leaf area and highly significant with leaf area and highly significant with leaf dry weight and both were positive. Association between root volume and root number was not significant and root volume and weight loss per cutting was nagative and not significant. Simple coefficient of correlation between root length leaf area and leaf dry weight were weak and not significant. It's association with weight loss per cutting was however highly significant. Leaf area was associated significantly at 1% level with leaf dry weight and not

CHAPTER 5

DISCUSSION

In all the periods of callusing, the hybrid Anab x American seedling was found to have an edge over all other varieties under trial in respect of the number of leaves per cutting, total leaf area, apical and basal shoot girth, number of roots, root volume, root fresh and dry weight, apical and basal shoot lengths, shoot volume, shoot dry weight and weight loss per cutting.

When the two varieties Anab-e-shahi and American seedlings were crossed, there was lot of vigour generated due to recombination of genes. This resulted in the formation of a vigorous hybrid which excels both parents in vegetative and reproductive growth (leaf, shoot and root growth). These findings are in conformity with those of Anon (1980) and Childer, (1975). Heavier vegetative growth (leaf, shoot and root weights) recorded for the hybrid is also indicative of the fact that one of it's parent is a labrusca type of grape which is characteristically more vigorous and wider adapted compared to the vinifera grapes to which most of the other varieties studied belong.

Potting mixture III favoured most of the parameters studied in the fresh cutting experiment, namely.- total leaf area per cutting, leaf dry and fresh weights, area per leaf, apical and basal shoot girth, number of roots, root

volume, root fresh and dry weights and shoot volume. The favourable effect of PMIII on the aformentioned parameters may be due to it's good aeration, moderate water holding capacity and the advantage of added farm yard manure (FYM) which improves fertility and water holding capacity without compromising aeration and drainage. This agrees with the work of Filden and Garner (1940) who reported that sand and a mixture of sand and top soil favour grape growth and that the best vineyards grow on moderately fertile, well drained sand or gravely loam soil which contain a good supply of organic matter. In fact, Childer (1975) claimed lighter sandy soil promotes earlier ripening vigorous vegetative growth and high sugar content of grapes than heavy soils. The other media tested in experiment with fresh cuttings, did not do as well as PMIII and sand. Poor performance of PMI and II was due to possession of high bulk density and low porosity thus impeding root formation and emergence. This agrees with the finding of Komissarov (1964). Grit in addition to the aformentioned short comings also has low organic matter content and low microbial activity as limiting factors, while sawdust afforded the base of the cuttings little aeration for optimum performance.

In the 3 weeks callus trial, the effect of rooting media on most of the parameters studied was not significant, except in the case of basal shoot girth, root dry weight, shoot fresh and dry weights and weight loss per

cutting. For all the aformentioned parameters, except the latter, (weight loss per cutting) ricehull gave better response compared to the other media tested. The enhanced performance of the cuttings propagated in this medium is attributed to it's water holding capacity, low bulk density and aeration and since the cuttings had developed absorptive tissues called callus through which they could take up water and nutrients, the water holding capacity of the medium was able to enhance the performance of the cuttings with respect to the parameter studied. Also the adequate aeration drainage and ability to form stable aggregates all contributed to the remarkable performance of rice-hull as a rooting substrate. This is similar to the findings of Anon (1980) who claimed that porous media are probably better than sand because they retain adequate air between particles and provide a satisfactory air: moisture relations in the rooting medium over a wider range of moisture content. This also agrees with the findings of Mbah and Odilli (1990) and Mba and Adesuyi (1990). The highest weight loss per cutting was recorded in sand and PMI. This is because of low water holding capacity of sand and poor drainage in PMI, causing the sprouted cuttings to continue to derive their nutrition from the stored photosynthates in the cuttings. This is so because, water is not held long enough in sand, to allow cutting absorb dissolved nutrients. While high bulk density and poor

drainage in PMI impedes root formation and growth, hence little or no roots are available to take up water and nutrient from the rooting medium. Woycicki and Terpinski (1937) reported that the relative moisture of sand had marked influence on rooting, and that sand with only 25% water holding capacity was unsuitable for propagating cuttings since most of the plants withered inspite of frequent irrigation. They considered rooting media with 50-75% water holding capacity the best. In experiment with 6 weeks callus cuttings, PMII enhanced better performance of the cuttings with respect to the parameters studied. This may be due to the high water holding capacity coupled with the presence of FYM in the medium. The FYM apart from improving the physical condition of the medium also serves as source of trace elements to the cuttings, which are taken up through the callus. This agrees with the findings of Dalrymple (1973) who reported that plants absorb through their roots or callus tissues, virtually all their water, most of the nutrients and some of the oxygen they utilize. It therefore becomes imperative that an ideal rooting medium should be fertile, aerated and retain adequate moisture. This is also similar to the findings of Olaniyan and Fawusi (1990) who reported increased plant height, leaf number and total dry weight in topsoil and a mixture of topsoil and poultry manure. Anab x American seedling in sand favoured total leaf area, apical and basal shoot

girth, shoot volume, leaf dry weight, root volume and root fresh and dry weights at 11 WAP in experiment with fresh cuttings, while in trial with 3 weeks callus cuttings, the same rooting medium-varietal combination favoured area per leaf, basal shoot girth, shoot fresh weight, root number and root fresh weight. This is due to the hybrid vigour exhibited by the planting material and the excellent physical characteristics (moderate water holding capacity, good drainage and aeration) of the medium. Leaf and root fresh weights, shoot volume, basal shoot girth of 3 weeks callus cuttings and total weight loss of 6 weeks callus cuttings were found to be highest in Anab x American propagated in grit. In case of the 3 weeks callus cuttings, the presence of some reserve material in the cuttings and the characteristic vigorous growth of the hybrid is responsible for their remarkable performance despite the relatively low nutrient status of the medium in question while in the 6 weeks callus experiment, less reserve material is present in the cuttings after callusing for 6 weeks (since the canes continue to respire and produce roots while wrapped up for callusing), this coupled with the low nutrient status of the medium and the characteristic vigorous growth of the hybrid caused much of the remaining stored material to be drawn upon, thus causing considerable weight loss of cuttings.

Anab x American propagated in PMIII resulted in highest apical and basal shoot girth, shoot volume and root dry weight in experiment with fresh cuttings and heavier fresh shoot in trial with 6 weeks callus cuttings. This is attributed to the vigorous growth characteristic of the hybrid, the influence of it's labrusca parent, all coupled with the excellent physical properties of the medium in which it is propagated, namely good drainage, moderate water holding capacity and aeration all these enhance root growth and consequently encourage vigorous vegetative growth. The added advantage of farm yard manure (FYM) also ensures that trace elements which are necessary for vigorous growth are made available to the growing cuttings. Highest apical shoot girth in experiment with both fresh and 3 weeks callus cuttings and root number in fresh cuttings were recorded when Anab x American cuttings were propagated in sawdust. This is due to the adequate drainage, water holding and friability of the medium which encouraged root and shoot growth coupled with the vigour of the hybrid. Bangalore blue in PMIII resulted in highest leaf fresh weight and root length in trial with fresh cuttings, this is due to the fact that the variety belongs to the vigorous labrusca grape and also the excellent characteristic of the medium. Queen golden in rice-hull resulted in higher shoot volume and shoot dry weight of 3 week callus cutting than all other rooting media x

varietal combinations, which is explained by the physical characteristic and vigour of these elements. While MKM-7 in PMIII gave highest shoot volume for cuttings planted after 6 weeks of callusing, this is because the variety belonged to the vigorous labrusca grape and was grown in an excellent medium with a good water holding capacity, bulk density, porosity, aeration and fertility.

In all the three experiments for all the four periods of sampling, the hybrid Anab x American seedling consistently gave significantly higher number of leaves per cutting which was however at par with other varieties under different callusing periods. In trial with fresh cuttings, the hybrid was observed to be at par with Black hamburgh, MKM-7 and Bangalore blue, with 3 weeks callus cuttings, number of leaves per cutting recorded for Anab x American was statistically at par with those produced by Black hamburgh and Queen golden, while MKM-7, and Catawaba performed equally as good as Anab x American with respect to number of leaves per cutting in experiments with 6 weeks callus cuttings. These could be attributed to the fact that all the varieties mentioned belong to the labrusca type of grape which is vegetatively more vigorous as stated earlier than vinifera grape.

When the rooting media were considered, PMI and II and grit were found to favour leaf production 2WAP in fresh cuttings. This is attributed to the favourable moisture

condition at this stage, when the formation of root is yet to take place.

At 5 and 11 WAP, PMIII, and sawdust were found to have an edge over all other media tested in experiment with fresh cuttings. This is due to the fact that, at this stage, roots are formed and a high water holding capacity hinders respiration of the roots due to lack of aeration which hinders proper activities of roots. This agrees with the findings of Dalrymple (1973) and Olaniyan and Fawusi (1990).

In experiment with 3 weeks callus cuttings, sand, grit and PMIII resulted in prolific leaf formation at 2 and 5 WAP. This is attributed to their moderate water holding capacity, (WHC) good drainage, and porosity. This is similar to the findings of Dalrymple (1973); Odiaka and Akoroda (1990) and Olaniyan and Fawusi (1990).

In experiment with 6 weeks callus cutting, MKM-7. In PMIII gave higher number of leaves than other rooting media x varietal combination at 2 and 11 WAP. The combination also gave significantly high number of leaves at 5WAP along with Anab x American in PMII and III. This phenomenon is due to the labrusca parents and the good characteristic of the rooting substrate employed.

Data collected for the four periods of sampling for the three periods of callusing, show Anab x American seedling to consistently result in longer apical shoot.

This was however found to be statistically same with shoot length produced by other varieties under different callusing periods. In experiment with fresh cuttings, the hybrid gave longest apical shoots at all the 4 periods of sampling. In trial with 3 weeks callus cuttings, the varieties Catawaba, Queen golden and Black hamburgh were observed to yield apical shoots which were statistically as long as those of Anab x American seedling, while experiment with 6 weeks callus cuttings, show Catawaba and MKM-7 to perform as good as Anab x American with respect to shoot length.

The performance of Anab x American and the other varieties could still be attributed to the hybrid vigour and the fact that these varieties all belong to the group of labrusca grapes which are vigorous growers.

When the rooting media were considered, PMIII was found to have an edge over all other media under trial in the experiment with fresh cuttings. This is due to better moisture condition, porosity, drainage and fertility of this medium which supported the cuttings well and brought out their potential for vigorous vegetative growth. In trial with 3 weeks callus cutting, PMIII, sand and grit encouraged production of longer apical shoot. This could be attributed to the moderate water holding capacity, porosity of these media. Rice-hull was found to favour apical shoot production at the later stage of growth

(11 WAP). This is because of the good porosity, aeration and stability of the aggregates of this medium which is conducive for root growth, which in turn enhances apical shoot growth. This is similar to the finding of Mba and Odilli (1990) . The cuttings planted had develope absorptive tissues, through which they could absorb water and nutrient for growth, in 6 weeks callus cuttings and since sand, rice-hull and sawdust do not hold as much water as the three potting media they couldn't have performed as well let alone better. Also the presence of FYM in the media which supplies trace elements gives an added advantage to the potting mixtures.

The hybrid Anab × American seedling in PmIII resulted in longer apical shoots in trial with fresh cuttings at all the sampling periods: 2, 5, 8 and 11 WAP. This is attributed to the relatively high vigour of the hybrid coupled with the good physical characteristics of the medium (moderate bulk density, water holding capacity, fertility, porosity, drainage and aeration) in addition, FYM in the medium serves as a source of trace elements. This agrees with the result of experiment conducted by Olaniyan and Fawusi (1990). In experiment with 3 weeks callus cuttings, the variety Catawaba in grit gave better response with respect to apical shoot length at 2, 5 and 8 WAP, while at 11WAP, Queen golden in rice-hull gave longer apical shoot. This is attributed to the genetic

composition of the variety, hence the varieties Catawaba and Queen golden may be vigorous at early and later stages of their growth. Catawaba in PMI, and both Anab x American and MKM-7 in PMIII gave longer shoots at 2, 5 and 11 WAP respectively in experiment with 6 weeks callus cutting. As seen in the 3 week callus experiment, Catawaba seem to be a vigorous variety especially at the early stages of growth, and since the cuttings had developed absorptive tissues called callus, the cuttings might have been absorbing water and nutrient through these tissues without forming roots, but after sometime when root formation begins, the mechanical impedance caused by the compact nature of PMI, begins to affect water and nutrient uptake, hence vegetative growth in general and shoot growth in particular. This is in conformity with result of research conducted by Schuurman (1971) and Drew and Goss (1973), who also observed a similar trend. At 5 and 11 WAP, the hybrid Anab x American seedling and MKM-7 both belonging to the vigorous labrusca type of grape and propagated in PMIII gave higher shoot length. The excellent physical characteristic and the additional advantage of FYM which is a source of trace elements, is responsible for this observation.

The hybrid Anab x American gave longest basal shoot in the experiment with fresh cuttings. This is attributed to the hybrid vigour and the labrusca genetic composition.

The media PMIII, sand and sawdust were found to have an edge over all other media under trial at 2 WAP. The performance of these media is due to their moderate water holding capacity drainage and aeration which enhances vigorous vegetative growth.

Varietal effect on basal shoot length in experiment with 3 weeks callus cuttings showed the varieties Anab-e-shahi, Thompson seedless and Regina produced shorter basal shoot at 5 WAP when compared with other varieties under trial. This could be attributed to the fact that the afformentioned varieties belong to the Vinifera grapes which are characteristically less vigorous compared to labrusca grape. The effect of medium on basal shoot length at 5WAP in experiment with 3 weeks callus cuttings showed grit, sawdust, sand and rice-hull to be better than the three potting mixtures due to their compactness, poor drainage, and aeration. While in experiment with 6 weeks callus cuttings, the varieties Anab x American, Catawaba and MKM-7 were better than other varieties tested with respect to basal shoot length at 8 and 11 WAP. This is accounted for by the fact that these varieties belong to the labrusca type of grapes and also due to their genetic composition. At 2WAP, Anab x American in PMIII yielded longer basal shoot while Bangalore blue in the sand medium gave longer basal shoot at 8 and 11 WAP in experiment with fresh cuttings. These may be attributed to the fact that

these varieties belong to the vigorous labrusca type of grape, coupled with the favourable rooting medium condition afforded by PMIII. The variety Bangalore blue was vigorous at the later stage. This may be a genetic characteristic of the variety.

Catawaba in grit and sawdust resulted in longer basal shoots at 5WAP. This may be attributed to the vigour of the labrusca parent coupled with the good physical characteristic of the medium. The variety MKM-7 in PMIII gave longest basal shoots in trials with 6 weeks callus cuttings, this may be attributed to the vigour of variety coupled with the optimum medium physical characteristics and the added advantage of FYM in the medium which also serves a source of micronutrient.

Root dry weight was significantly associated either at 5 or 1% levels with root length in all the three experiments, which is quite logical because the longer the roots, the heavier will be the dry root weight. When it's association was studied in relation to root volume it was highly significant in all the three experiments which is also quite in order, because the greater the volume of roots, the higher is the root dry weight. The correlation between root dry weight and root number was highly significant in two experiments and not significant in experiment with 3 weeks callus cuttings. It seems in this case, that because of the absorptive callus formed in

3 weeks callus cuttings, not much roots were developed. The association between root dry weight and total leaf area was highly significant in fresh cuttings and not significant for 3 and 6 weeks callus experiments. This is obvious because in fresh cuttings the sprouting of buds and expansion of leaves started much earlier with much of the reserve material in the cutting still intact, whereas in callusing, the bud burst and leaf expansion started much later when some of the reserved material had been deplected while callusing. Root dry weight association with leaf dry weight was highly significant at 0 and 3 week after callusing and not significant at 6 weeks callusing.

This is also logical, because the buds in the 6 weeks callus experiment were dormant for longer time than the other two experiments and much of the stored food might have been used up, this energy is available for leaf production. Weight loss was not significant for the first two experiments (0 and 3 week callusing), but was highly significant at 6 weeks. This is because the cuttings in the experiment with 6 weeks callus trials, used up lot of the stored photosynthate present in the cane during their prolonged callusing.

The significant association of root length with root volume in fresh cuttings, it's high significance in 3 weeks callus experiment and non significance in 6 week callus trial is indicative of the fact that in the latter case,

because of well developed callus, the volume of roots was much smaller. Association between root length and root number was highly significant in 3 and 6 weeks callus experiment. This shows that both root length and root number were produced more in fresh cuttings. In case of 3 and 6 weeks callusing, due to presence of callus which serves as absorptive tissue no significant root length nor significant number of roots were produced.

The coefficient between root length and leaf dry weight were either significant or highly significant in all the three experiments which is due to the fact that the longer the roots, the higher the amount of nutrient uptake, and hence the more vigorous the vegetative growth. This invariably resulted in heavier leaf dry weight.

CHAPTER 6

SUMMARY AND CONCLUSION

Investigations were carried out at the Institute for Agricultural Research farm, Samaru, Zaria, during the 1992 dry season to determine the effect of seven rooting media on the root and shoot growth of eleven varieties of grapevine Vitis vinifera L. Three experiments were conducted using fresh, 3 and 6 weeks callused cuttings. The rooting media and varieties, constituted the main and subtreatments respectively. The treatments were laid out in a split plot design replicated six times.

The hybrid Anab x American seedling was found to have an edge over other varieties tested in total leaf area, shoot length apical and basal shoot girth, number of roots, root volume, root fresh and dry weight, shoot volume, shoot dry weight, weight loss per cutting, area per leaf, leaf dry weight and number of leaves in all the three experiments.

The rooting media PMIII was observed to result in optimum performance of the fresh cuttings with respect to all the parameters studied. While rice-hull as rooting substrated was found to have an edge over other media tested in experiment with 3 weeks callus cuttings. PMII was observed to be better than other media under trial in 6 weeks callus cuttings.

Correlation studies revealed a positive and strong association between root dry weight with root volume and root length in all the 3 experiments. Association was also significant and positive between root dry weight and number of roots in fresh and 3 weeks callus trials. When the three callusing periods were compared, the experiment with fresh cutting were found to perform better than the other two experiments involving 3 and 6 weeks callused cuttings with respect to most of the parameters studied. This may be due to the fact that callus tissues formed at the lower end of the canes posses corky deposits from phellogen. This protective tissues are only slightly permeable to water and nutrient. Therefore even if there is a well developed conductive system, the callus absorbed and conduct water very poorly into the stem and leaves of these cuttings. This is quite insignificant compared with the amount of water expended by the leaves. This is similar to the finding of Komissarov (1964).

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Appendix 1: Meterological components sunshine hours, minimum and maximum tempratures and relative humidity in Samaru during the period of the experiments.

Oate	Sunshine hours/day	Temperature(o^{c}) min	max	Relative humidity (% 10am	4pm
29/09-5/10/92	9.4	19.7	30.5	66.3	54.4
6/10-12/10	8.8	19.2	31.2	66.8	48.3
13/10-19/10	9.2	10.4	31.5	63.5	43.1
20/10-26/10	9.3	18.1	31.7	55.0	37.7
27/10-2/11	9.4	17.0	31.4	46.5	29.6
3/11-2/11	9.9	16.0	31.5	30.9	22.6
10/11-16/11	9.9	17.0	31.1	27.0	20.9
17/11-23/11	9.2	18.0	30.5	26.3	20.8
24/11-30/11	9.4	16.6	30.4	25.0	20.0
1/12-7/12	10.0	15.4	30.1	24.0	19.0
8/12-14/12	9.3	13.8	29.5	22.0	17.3
15/12-21/12	9.6	13.6	30.1	19.0	14.9
22/12-28/12	9.0	13.5	29.0	20.2	15.3
29/12-4/1/93	9.7	14.7	29.0	19.7	15.4

Source: Meterological Station Institute of Agricultural Research Zaria.

Appendix II: *Composition of the rooting media* (maintreatments): (Percent composition)

	Sand	Topsoil	FYM	Grit	Rice-hull	Sawdust
M_1(PMI)	25	37.5	37.5			
M_2(PMII)	50	25	25			
M_3(PMIII)	75	12.5	12.5			
M_4	100	-				
M_5	-	-		100		
M_6	-	-			100	
M_7	-	-				100

Appendix III: Varieties (subtreatments)

S_1	-	Anab-e-shahi
S_2	-	Anab x Ameican seedling
S_3	-	Bangalore blue
S_4	-	Black hamburgh
S_5	-	Cardinal
S_6	-	Catawaba
S_7	-	Ex-Zaria-black
S_8	-	MKM-7
S_9	-	Regina
S_{10}	-	Thompson seedless
S_{11}	-	Queen golden.

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When God created the world, He allocated His blessings in many ways in comprehensible to us that it is impossible to detect what decision-making model He applied in determining who get what, where and how much and how. To some, He assigned to swamps. Some received snow and others the monsoons; some too much water and others, no water at all. In the allocation proces one occasionally suspect that He might have played favourites for a few while some managed to inherit all the natural calamities.



Lawal, A.B.

Dec. 1993.

KEEP BELIEVING IN YOURSELF and YOUR SPECIAL DREAMS

There may be days when you wake up in the morning and things ain't the way you had hope they will be. That's when you have to tell yourself that things will get better. There are times when people disappoint you and let you down. But those are the times when you must remind yourself to trust your own judgements and opinions. To keep your life focused on believing in yourself and all that you're capable of .....



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