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To the Graduate Council:

I am submitting herewith a thesis written by Kodialguthu Radhakrishna Alwa entitled "Studies on the use of peat and perlite as media for growing vegetable plants." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Landscape Architecture.

B.S. Pickett, Major Professor

We have read this thesis and recommend its acceptance:

H.D. Swingle, J.S. Alexander

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

August 4, 1961

To the Graduate Council:

I am submitting a thesis written by Kodialguthu Radhakrishna Alwa entitled "Studies on the Use of Peat and Perlite as Media for Growing Vegetable Plants." I recommend that it be accepted for nine quarter hours credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Horticulture.

[illegible]
Major Professor

We have read this thesis and recommend its acceptance:

Homer D. Swingle

Joe S. Alexander

Accepted for the Council:

J. E. Spivey
Dean of the Graduate School

STUDIES ON THE USE OF PEAT AND PERLITE AS MEDIA FOR GROWING VEGETABLE PLANTS

A Thesis
Presented to
the Graduate Council of
The University of Tennessee

In Partial Fulfillment
of the Requuirements for the Degree
Master of Science

---

by
Kodialguthu Radhakrishna Alwa
August 1961

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CHAPTER I

INTRODUCTION

The success of many vegetable enterprises depends greatly upon the production of healthy and vigorous plants for field setting. There are many problems confronting the producer in this phase of horticulture. While facilities like greenhouse, plant beds and other equipment must be available and properly controlled, successful plant growing is just as dependent upon the media in which the plants are raised.

During the year 1959 (16), in the State of Tennessee alone, cut-flowers, potted plants, florist greens and bedding plants were grown under glass covering an area of 2,236,126 square feet. Vegetables, flower seeds, vegetable seeds and vegetable plants were grown under glass covering 175,972 square feet.

Soil as propagating media has drawbacks and poses many problems. The presence of soil pathogens is an important factor not to be ignored in plant production. Damping-off and related diseases of nursery crops are most frequently caused by soil borne Rhizoctonia solanii, but also by water molds (Phythium and Phytopthora Spp). The eradication of these pathogens is both costly and laborious. The presence of nematodes and noxious weed seeds in the soil causes much damage. The eradication of nematodes from soil involves high cost and labor. Removal of weeds from the seed bed is equally laborious and costly.

Small amounts of various salts are necessary for plant development, but excessive concenterations cause injury or death. Salts accumulate in soils from irrigation water or from application of fertilizers in excessive amounts or by the use of manures gathered in places where they have accumulated large amounts of salts. Such salt accumulations result in death or weakening of the plant making it more susceptible to attack by pathogens.

In general, media used in growing plants need to be sterilized either chemically or by heat. Plant injury due to toxins, is another of the important problems facing the grower using the conventional treated soil mixes. Soil mixtures high in readily decomposeable organic matter are most likely to give injury after steaming. The plants may develop injury, such as stunting, dropping of leaves, root corrosion, or even die.

The problems stated above, led the growers to seek a uniform mixture for raising seedlings and nursery stock successfully. This resulted in the development of the John Innes mixes at the John Innes Horticultural Institution during 1934-39. But these mixes had disadvantages in that, variability resulted from the use of composted nonuniform turf. The time involved, space and labor, as well as toxic residues being produced after steaming left much to be desired. These drawbacks led to the development of the University of California system of soil mixes and treatments, in 1941 (I). The physical base of the U. C. -type mix consists of an inorganic material-fine sand, and an organic fraction - sphagnum peat moss properly fertilized. This mix has many desireable features such as, chemical uniformity and relative inertness, good drainage and aeration, relatively inexpensive, light in weight and satisfactory water holding capacity.

Investigations in the use of inorganic materials as a base for plant growing has led recently to perlite - an inorganic material of volcanic origin. Much work has been done at the Texas Agricultural Experiment Station (10), and is being done in other places on the use of perlite for raising ornamental plants, but work on its use as a media for raising vegetable plants is meagre.

The object of the present study, is to evaluate the use of the inorganic material perlite in combination with organic fraction peat moss in raising vegetable plants. The investigation aims at bringing out the effect of various combinations of such media on the germination, growth rate and yield of plants.

CHAPTER II

REVIEW OF LITERATURE

I. IMPORTANCE OF PLANT INDUSTRY

Thompson and Kelly (48), reported that starting plants in greenhouses or other forcing structures lengthens the growing season making it possible to grow long season crops in regions where summers are short. It makes more than one crop possible on the same land in a single growing season. It protects plants from unfavorable weather. It also helps to obtain larger yields of long season tender crops when grown where summers are short. It is also possible to produce an earlier crop by planting seed before it would be safe to plant in the open.

Many commercial vegetables in the State of Tennessee are profitable only when an early harvest is possible. Much of the value of a home garden is due to early crops. A number of the cool season vegetables like cabbage and lettuce will not mature satisfactorily during hot weather. Because of the limited favorable season at this latitude and elevation it is essential to start with plants (20).

In the State of Tennessee (16), 1526 acres were planted to cabbage, 3413 acres to tomatoes, 967 acres to sweet peppers, 5156 acres to other vegetables. Most of these vegetables are raised from transplants that involved the use of plant beds, or geenhouses and suitable media for producing the seedlings required.

II. SOIL AS A MEDIUM - ITS USES AND DRAWBACKS

Soil has occupied the foremost position as a plant propagating medium through the ages.

Honma (22) reported that total yields of cabbage and tomato are not affected by the media. But where early tomato yields are considered the use of soil favored larger yields. Baumgartner (6) found in his studies on the mixtures to be used for container grown plants, that soil did not contribute to improved plant growth. In North Carolina commercial vegetable growers (26), prefer to make up a media by mixing garden top-soil, sharp sand and some form of organic matter.

Drawbacks in the Use of Soil as a Medium.

Pathogens. Damping-off and related diseases (such as seed decay, top rot, cutting and stem rot, and root rot of mature plants) of nursery crops are most frequently caused by Rhizoctonia Solanii, but also by water molds (*Pythium* and *Phytopthora* spp.) (1) Baker (1) reported that losses caused by a disease are determined by the interaction of several factors of which the abundance and virulence of the pathogen in the soil is an important factor to reckon with. Pearson and Chilton (39) reported that damping-off of tomatoes and bell peppers can be controlled by seed treatment with red copper oxide, while Vasco 4 and Zinc Oxide gave good results with egg plants and cabbage. Doran *et al*. (11) found that there is no one best standard dry chemical treatment for the seeds of all vegetables. Red copper oxide is to be preferred for some, Semesan for others and zinc oxide for still others. They also found that formaldehyde gave good results when applied to soil by sub-irrigation provided that the soil did not already contain too much water.

An ideal chemical for treating soil is one that (35), kills a variety of fungi, bacteria, insects, and weeds; is inexpensive and harmless to the operator and equipment, is quick acting and effective deep in the soil as well as on the surface; is harmless to nearby plants; and is nontoxic to subsequent plantings in the soil. Munnecke (35) reported that none of the presently known chemicals fulfill all of these requirements, but many fulfill enough of them for practical use.

Nematodes.

Soil inhabiting parasites are of many kind, of these, perhaps the best known are the root knot nematodes of the genus Meloidogyne. Taylor (47) reported that plant parasitic nematodes are most prevalent and did the most damage in the south and other warm regions of the United States on vegetables and other crops, because a long growing season is favorable for their multiplication.

Newhall and Lear (37) observed that chloropicrin and methyl bromide are the important soil fumigants for nematode control in greenhouses and plant propagating establishments. Taylor (47) found that methyl bromide and chloropicrin are expensive and are used where crops of very high value are grown in greenhouses, seed beds and nurseries. The cost of soil treatment with methyl bromide and chloropicrin being about 2.9 to 3.2 cents and 1.9 to 3.0 cents per cubic foot of soil resepctively exclusive of labor (2).

Weeds. The presence of weed seeds is an important drawback in the use of soil as a medium. The weed seeds germinate and grow at the expense of the plants and the elimination of the weeds entails high cost which eventually increases production costs. Baker and Roistacher (2) reported that since some growers spend 3 to 4 cents a flat for weeding, they are enthusiastic concerning the benefit from heat and chemical treatment. They further observed that very few weed seeds survive heat treatment of soil, and even these may be eliminated if germination is started by keeping the soil moist for a few days prior to mixing and treatment.

The cost of eradication of weed seeds either by heat or chemical treatment ranges from 2 cents to 3.2 cents per cubic foot of soil excluding cost of labor (2).

Salinity. In nursery soils the origin of harmful salts is most frequently from chemical and organic fertilizers which have been used in excess (1). Improper irrigation practices and poor drainage restricts leaching and may therefore lead to salt accumulation. Hunter (23) observed that use of clay pots also contributes to salinity problem, because moisture evaporation on the outside surface leaves behind the soluble minerals in concentrated form.

Schoonover and Sciaroni (43) reported that the salinity problem is overcome by using proper irrigation practices, providing drainage is open and avoiding over fertilization.

Toxicity. Matkins, Chandler and Baker (30) reported that toxic residue is apparently produced if the soil is steamed after mixing, and it lasts for a period or several months, particularly if the soil is kept sterile and dry. They further contend that this toxicity is due to accumulation of ammonia because of the destruction of the ammonifying organisms, break down of organic matter, release of toxic manganese in some soils, and release of absorbed salts by some soil ingredients.

Weibe (52) in his studies on the toxicity problem in soils sterilized by steam found, that the plant response is negatively correlated with an increase in osmotic concentration due to heating of the soil. He has discounted the suggestion that ammonia brings about reduced growth, because four materials of similar osmotic concenterations tried by him gave similar growth response.

III. BASIS OF VARIOUS MEDIA

Sand. Baumgartner (6) in his studies on the mixtures to be used for container grown plants at the Baumlanda Horticultural Research Laboratory at Crotonfall, New York found that sand was excellent for maintaining a porous mixture during the first year, but became more difficult to wet after this period. Some sands he observed presented a cement like surface which repelled water. In Ontario (51) a widely used media for the growing of vegetable transplants is a mixture of 7 parts by volume of fertile sandy or light clay loam, 3 parts of peat and 2 parts of sharp sand. Honma(22) reported on coarse grade sand as a media for raising cabbage and tomato plants yield was not affected and plants could also be easily removed from the beds, Plants in coarse sand required less than one third of the transportation space needed by banded plants grown in soil. Thus fewer trips were needed between the greenhouse and the field. He noted also that the sand grown plants required only one-half as much time for planting as the soil grown plants.

Erickson and Wedding (14) in the studies conducted to find how often to apply minerals to plants raised in the greenhouse in different media reported, that sand made poor showing when the various applications were compared. However, sand ranked first for four crops and was significantly better than all the other media for two of them.

Peat. Incorporating peat into soils, particularly to those low in organic matter, improves the soil in several ways. Peat increases water intake and water holding capacity. Once water is absorbed, it reduces soil erosion. Because the organic material occuring in peat is lignified, it decomposes slowly so that its beneficial effect is spread over several years (24). Since dried cow manure is rather expensive,and fresh manure is not always available, the other substitute that gave the same increases in yield was native peat moss (25). In studies on mixtures to be used with container grown plants made at the Baumlanda Horticultural Research Laboratory(6), it was found that peat is essential in all mixes, but no advantage could be noted when it was used in quantities of more than 25 per cent in any of the mixes, except the perlite-peat combination.

Erickson and Wedding (14) found the addition of peat to sand improves the water holding capacity to some extent and places this medium in the class with soil-sand-peat as the best to use in growing plants in the greenhouse.

Baumann (5) found that a peat media to which individual nutrients or a complete fertilizer had been added, was superior to a compost soil mix for raising seedlings of several types of vegetables. Reeker (42) recommends the addition of lime at 1.5 grams per litre of loosened sphagnum peat for making a satisfactory medium for raising ornamental plants.

John Innes Composts. Tests at the John Innes Horticultural Institution during 1934-39 (1), demonstrated that a single soil mixture could with minor modifications, be used for growing a wide range of plants. The importance of this finding has slowly been appreciated by growers in England, Europe and the U. S. A. The John Innes Compost is a fertilized mixture of medium loam which is the composted residue of a 4 to 5 inch layer of turf removed from pastures or meadows, peat and coarse sand. Since they failed, to eliminate several serious inherent disadvantages common also to conventional soil mixes, further work had to be undertaken to evolve soil mixes that were more usable. Steavenson (45) found that among the soil mixtures for container stock tried, greatest shrinkage was apparent in the John Innes Compost.

University of California Soil Mix. Work was begun at the University of California at Los Angeles in 1941 to find a better soil for growing plants in containers than that then available. Work on the development of the mix was first reported in 1948 by Baker (3), he reported that a mix with three parts of Canadian peat and seven parts of sandy loam was found which could be fertilized before steaming, and had no toxic effect on a wide range of plants grown in this mix even if planted immediately after steaming. Further development of this mix was continued, and in 1952 Chandler (7), reports five representative formulations of two ingredients, fine sand and peat, with various combinations of fertilizer additions. Collectively these have been named the U. C. soil mix (1).

Vermiculite. This is a micaceous mineral found extensively in Montana and South Carolina. It is chemically hydrated magnesium-aluminum-iron slicate which is neutral in reaction, insoluble in water, and absorbs large quantities of water and expands markedly when heated(19).

Barrett and Arisumi (4) reported that the difficulty of inducing fiborous roots on tap root tree seedlings was overcome by growing such seedlings in Vermiculite. Cortvriendt and Degroote (9) found that when two and one year old azaleas were planted in vermiculite and sub-irrigated they developed larger flowers and very considerably exceeded the flowering period of the controls. Shugert (44) obtained reduction in rotting and improvement in rooting when vermiculite was used instead of sand for rooting hormone treated cuttings under constant mist. Puccini (41) reported that fine vermiculite might be a suitable medium for germinating seeds of succulent plants and of slow germinating seeds that require a high constant moisture for a long time. Mullard (34) observed that loss of cuttings due to stem rot can be minimized by allowing only the tips of the cuttings to be in contact with vermiculite kept saturated with sub-irrigation water.

Emsweller (13) reported that in growing annual flowering plants seeds planted in vermiculite germinated more readily and the percentage of germination was higher. There was also no trouble with weed seeds or damping-off fungi since vermiculite is prepared at very high temperatures that kill all disease organisms and weed seeds that might be present. Escritt (15) found that exfoliated vermiculite incorporated into the seed bed gave temporary benefits in establishing turf from seed. He further observed that as a top dressing for turf fine vermiculite tended to produce a soft surface and raised the pH of the soil. Pew (40) found that where vermiculite was used as a mulch and applied as a band half inch deep and one inch wide, the total yield of fall head lettuce was 23 per cent higher, and the emergence of cantaloupe seedlings were improved by the application of vermiculite at planting time.

Ticquet (49) stated that the nutrient elements may accumulate to toxic concentrations after a period of 3 to 6 years on surface of culture medium consisting of a porous material like vermiculite.

Other media. Tuljzenkova (50) found that growing of vegetables in moss with suitable nutrients added to it was an advantageous substitute for ordinary soil. Edson (12) found that in Florida the use of sawdust as a rooting medium for growing tomatoes and cucumber in small scale hydroponics gave particularly high yields when the culture solutions were maintained below the sawdust.

IV. THE USE OF PERLITE IN HORTICULTURE

Perlite is a form of volcanic mineral (27) which expands up to 13 times its original volume when heated to above 1800°F. It is white in color, light in weight, weighing 6 to 9 pounds per cubic foot. It is nontoxic, clean and safe to handle. It is sterile, assures uniform mixing and does not deteriorate. Its pH is essentially neutral and has a water holding capacity of 300 to 400 per cent. Perlite is odorless, and presents no storage or application problems and is not inflammable.

Morrisson et al. (33) reported that perlite could not sustain growth of cress without added fertilizers, but with nutrient solution added at 7 to 10 day intervals produced similar growth to that in a potting soil. Baumgartner (6) studied various mixes for container grown plants and came to the conclusion that the perlite-peat mixture was the most flexible and uniform potting mixture. Galle (17) observed that in the Spring Hill nurseries, Tipp City, Oregon miniature roses are propagated from hardwood or softwood cuttings at 60°F in a medium of sand and perlite. He further reported (18) that in Red Bank, New Jersey that hollies are propagated under high temperatures and humidity in a medium of perlite and peat moss. Hobbs (21) studied, the storage of rooted cuttings at different temperatures using bare root, sphagmum moss and perlite as packing materials. He found that with holly cuttings stored at 36°F - 44°F spagnum was significantly better than perlite but with arborvitae and thuja cuttings perlite was significantly better.

Mahlstede (29) found at Cornell University that when various combinations of loam, peat, vermiculite and perlite were used as a media for the production of nursery stock in containers that combinations of peat and perlite media had excellent growing properties. The landscape architect Karl Linn made green gardens of English Ivy on the roof (36) of the skyscraper Seagram building in New York using a media of perlite, peat moss since it is light in weight.

A recent experiment in hydroponic gardening in a penthouse garden in New York City(38), opened the way to more successful soilless culture by amateurs. For the first time on any large scale, the plants were grown in a mixture of equal parts of perlite and peat moss. Dewerth and Odom (10) reported that nursery stock of ornamental plants produced in mixtures containing equal parts of peat moss and perlite did not shrink away from the sides of the containers, and the general health, color and size of the plants were superior to all other plants grown in other mixtures.

Literature on the use of perlite as a medium for raising vegetable seedlings is meagre. Morrisson (32) reported that a succession of short rotation crops like lettuce can be obtained from a single sowing by pricking out from the germination dishes only as many seedlings as are required, while the others will live on in perlite which has received no fertilizers without increasing in size until required for a subseqent planting.

CHAPTER III

MATERIALS AND METHODS

I. SEEDING AND POTTING MIXES STUDIED.

The seeding media used in this study were five in number. These media were mixed and sterilized with steam prior to sowing the vegetable seeds. The details regarding the materials used in each of the respective media is given below:

1) Soil + Sand (Coarse) + Compost - 1:1:1
2) Peat-perlite (1:1) + U. C. Mix

The U. C. Mix consisted of the following fertilizer ingredients in a cubic yard of the mixture.

a) Potassium nitrate	6 oz.
b) Potassium sulfate	4 oz.
c) Single superphosphate	$2\frac{1}{2}$ lb.
d) Dolomite lime	$4\frac{1}{2}$ lb.
e) Calcium Carbonate lime	$1\frac{1}{4}$ lb.
f) Gypsum	$1\frac{1}{4}$ lb.

3) Peat-perlite (1:1) + Texas mix

The Texas mix consisted of the following fertilizer ingredients in a cubic yard of the mixture.

a) Single superphosphate	5 lb.
b) Dolomite lime	6 lb.
c) Complete fertilizer 5-10-5	5 lb.

4) Peat-perlite (1:1) + Hyponex.

Hyponex is a soluble plant food manufactured by the Hydroponic Chemical Company Inc., Copely, Ohio. It has an anlysis of 7-6-19. It is made up of potassium nitrate, ammonium sulfate and triple superphosphate. The dosage of this material was one teaspoon (5 grams approx.) per gallon of water and one quart of the solution was added to 300 cubic inches of the medium just after sowing the seeds.

5) Perlite

The potting media into which seedlings were to be pricked were mixed and steam sterilized. The details regarding the composition of the various potting media are given below:

1) Soil + Compost (3:1)
2) Peat-perlite (1:1) + U. C. mix
3) Peat-perlite (1:1 + Texas mix
4) Peat-perlite (1:1) + Hyponex

The Hyponex solution was added to the medium once just after the seedlings were pricked at one teaspoon per gallon of water, and one quart of the solution was added to 300 cubic inches of the medium.

Horticultural perlite grade No. 8 and imported peat moss were used in all combinations.

II. KINDS OF VEGETABLES STUDIED

Cabbage, lettuce, tomato, egg-plant and pepper were studied in regard to their germination in the seeding media and the growth of plants in the potting media.

The varieties of each of the vegetables is given below:

a) Cabbage - Golden Acre Yellows Resistant
b) Lettuce - Grand Rapids
c) Tomato - Rutgers
d) Eggplant - Florida Market
e) Pepper - Keystone Resistant Giant

In the potting media the same varieties were grown, except that tomato variety Manalucie was used.

The seeds of eggplant and pepper were treated by the firms that supplied the seeds. The seeds of the other vegetable were treated with Captan prior to sowing.

III. GERMINATION STUDIES

The study was conducted in No. 42 Market Pak peat-pulp flats. The seeds of each of the vegetables were sown in single rows in each of the flats containing the various media. The sowings were made according to a split plot design replicated four times. Fifty seeds each of the vegetables tested were sown. The sowings were made on February 25, 1961. The flats were kept on a greenhouse bench at a temperature range of 60-70°F.

Periodic counts on the germination of the seeds were recorded. In case of cabbage and lettuce the effect of media on seedling dry weight of tops and roots were studied. Plate 1 depicts the plot arrangement of seeding media.

IV. SEEDING MEDIA

In order to evaluate the effect of seedling media on recovery and development of plants when transplanted to a wider spacing, such as in pots or bands, plants of each vegetable were pricked into 2" x 2" x 2½" vita bands arranged in a randomised block design with four replicates Seven plants were used of each of the five vegetables. A 3:1 soil-compost mixture was used. Seedlings were maintained at a temperature range of 60-70°F. All seedlings were sprayed with Captan and Malathion as prophy-

PLATE 1

Plot arrangement of seeding media

laxis against damping-off and aphids respectively. Cabbage and lettuce seedlings were pricked 15 days (March 11) after sowing. Forty-five days (April 26) after banding measurements were taken of height and fresh weight. The spread of lettuce was also recorded.

Tomato seedlings were pricked 20 days (March 17) after sowing. Five plants were removed from the bands 40 days (April 26) after pricking and measurements of height, fresh weight and thickness of stem recorded.

Seedlings of eggplant were pricked 30 days (March 26) after sowing. These seedlings were allowed to remain in bands for 40 days (May 6), and five plants were then removed and their height and fresh weight recorded.

Pepper seedlings when 32 days old (March 29) were pricked into bands. After remaining in bands for 42 days (May 10) five plants were removed and their height and fresh weight recorded.

V. POTTING MEDIA

To measure the effect of potting media on growth and development, plants of the five vegetables were raised in the four different potting media, and these plants were later set in the field. The varieties of the vegetables raised were the same as those in the seeding media, except that in tomato the variety Manalucie was used. The seeds of cabbage, lettuce, eggplant and pepper were sown on March 1, in a uniform sterilized seeding media of soil, sand and compost 1:1:1. Fourteen seedlings of each of the vegetables were pricked into 2"x2"x2½" vita bands arranged in a randomised block design with five replicates and containing the 4 sterilized potting media described earlier in this chapter.

The cabbage seedlings were pricked 22 days (March 23) after sowing while the lettuce and eggplant were pricked 23 days (March 24) after sowing. The tomato seedlings which were sown on April 1, were 22 days old (April 23) when pricked, while the pepper seedlings were a month old (March 30).

All the seedlings were sprayed with Captan and Malthion as a prophylactic measure against damage from damping-off and aphids respectively. The seedlings were maintained at 65-75 °F in the greenhouse, and 10 to 15 days before field set they were moved to cold frames.

VI. FIELD STUDIES WITH PLANTS RAISED IN DIFFERENT MEDIA

Field Treatments.

Before the vegetables plants were field set, a visual rating of 1 to 5 was adopted to assess their growth and general condition. The best plants were given a rating of 5 and the poorest plants 1.

All the vegetable transplants were planted in the University of Tennessee Cherokee farm plots. The soil series was Abernathy, silt loam. During the preparation the plots received 800 pounds per acre of 6-12-12 fertilizer which was applied broad-cast and another 400 pounds per acre of the same analysis fertilizer was applied in the rows. For tomato plots instead of 400 pounds per acre the dosage was increased to 800 pounds per acre.

The transplants were planted on different dates, ten transplants for each treatment of each of the five vegetables were planted in a randomised block design with five replicates. The details in regard to the planting dates and distances are given below:

Cabbage. The transplants were set in the field 36 days (April 28) after pricking. They were planted at a spacing of one foot between plants, and 3 feet between rows.

Top dressing with ammonium nitrate at 100 pounds per acre was done 22 days (May 25) after field setting.

Lettuce. The transplants were set in the field 34 days (April 27) after pricking. The plants were spaced 6 inches apart in the row and 3 feet between rows.

Top dressing with ammonium nitrate at 100 pounds per acre was done 23 days (May 20th) after field setting.

Tomato. The field setting of tomato transplants were made 24 days (May 17) after pricking. The plants were spaced 2 feet apart in the row and 4 feet between rows.

After staking the tomato, the first pruning was made 24 days (June 10) after field setting. This was done when the second lateral below the inflorescence had reached one inch in length. The two stem system of training was used.

Eggplant. The eggplants were set in the field 42 days (May 5) after pricking. The spacing adopted for these plants were 3 feet between plants and 4 feet between rows. All plants grew satisfactorily.

Growth Studies.

Cabbage. The heads were harvested 60 days (June 29) after field setting. The yields in respect of the weight of heads produced by various treatments and also the number of plants that formed heads were recorded.

Lettuce. The bunches were harvested 50 days (June 16) after field setting. Observation on the yield of leaf lettuce produced in various treatment, and also the number of plants maturing were recorded.

Tomato. Observations were taken on lateral shoot development, with reference to the number of plants in the various treatments that reached the pruning stage by a specific date.

The effect of the treatments on the number of plants that formed early fruits was also studied, as well as the number of fruits produced in the first cluster by plants raised in the different media.

Eggplant. Observations were made on the effect of different media on the number of first flowers formed, and also on the number of first fruits formed in plants under the various treatments.

Pepper. The details in regard to the number of fruits produced in plants under the various treatments, 54 and 60 days after field settings were recorded.

The data obtained concerning growth characteristics of all the crops were statistically analysed.

CHAPTER IV

EXPERIMENTAL RESULTS

I. MEDIA CHARACTERISTICS

The seeding and potting media used were tested with a pH meter and with a "Simplex" soil test out-fit for pH and the nitrate nitrogen. The results of these tests are shown in Table I.

The result indicates that the media with soil, sand and compost was almost neutral in reaction and contained a fair amount of nitrate nitrogen, while the media with peat-perlite U. C. mix and Texas mix was acid in reaction and contained high amounts of nitrate nitrogen.

The peat-perlite medium with Hyponex was acid in reaction and contained a low quantity of nitrate nitrogen. The pure perlite medium was neutral in reaction and contained traces of nitrate nitrogen. Visual observation on the water holding capacity of the various media indicated that the soil, sand and compost medium had a low water holding capacity compared to the media with peat and perlite combinations.

II. EFFECT OF MEDIA ON GERMINATION

Since vegetables require different periods of time to germinate, counts were taken 8, 9 and 12 days after seeding. Average values for the different media on the percentage germinated is furnished in Tables II to IV.

In Table II the results indicate that 8 days after sowing there was no difference in the percentage of germination of cabbage and lettuce, though tomato seeds showed a lower percentage, its germination was higher than eggplant and pepper.

Regarding the media, soil, sand and compost (T_1), peat-perlite plus U. C. mix (T_2) and peat-perlite plus Hyponex (T_4) were superior to peat-perlite plus Texas Mix (T_3) and pure perlite (T_5). Between the last two media there was no significant difference in effect on seed germination.

Interaction was found to exist between the vegetables and the different media at both 5 percent and 1 percent levels.

The results presented in Table III show that 9 days after sowing seeds of cabbage and lettuce are similar in percentage germination, while tomato, eggplant and pepper differ significantly. Pepper seeds had not yet started germinating. Taking media into consideration, the peat-perlite Texas mix and perlite alone were poor media in which to germinate the vegetables tested.

Interaction was found to exist between the vegetables and the different media at both 5 percent and 1 percent levels.

The results shown in Table IV indicate that 12 days after sowing all the vegetables except pepper were similar in their percentage of germination, but peppers were late in germinating. Soil, sand and compost (T_1) was a significantly superior medium, while the peat-perlite U. C. mix (T_2) and peat-perlite Texas mix (T_3) were next best.

Interaction was found to exist between the vegetables and the different media at the 5 percent and 1 percent levels.

TABLE I

THE pH AND NITRATE NITROGEN IN THE SEEDING AND POTTING MEDIA

Treatment No.	Treatments (Seeding & Potting)	pH	Nitrate Nitrogen
1	Soil + Sand + Compost 1:1:1	7.25	25ppm
2	Peat-Perlite + U. C. mix	5.18	40ppm
3	Peat-Perlite + Texas mix	4.80	75ppm
4	Peat-Perlite + Hyponex	4.22	6ppm
5	Perlite.	6.85	1ppm

TABLE II

THE EFFECT OF MEDIA ON GERMINATION OF VEGETABLE SEEDS:
(OBSERVED 8 DAYS AFTER SOWING)

I. Main Treatments:

Treatment No.	Treatments (media)	% Germination (Av. values)
1	Soil + Sand + Compost 1:1:1	47.9
2	Peat-Perlite + U.C. mix	48.3
3	Peat-Perlite + Texas mix	42.3
4	Peat-Perlite + Hyponex	46.8
5	Perlite	39.6
	L.S.D. at 5% level	3.1
	L.S.D. at 1% level	4.4

II. Sub-treatments:

Treatment No.	Treatments (vegetables)	% Germination (Av. values)
1	Cabbage	96.4
2	Lettuce	96.5
3	Tomato	32.0
4	Eggplant	0.0
5	Pepper	0.0
	L.S.D. at 5% level	3.3
	L.S.D. at 1% level	4.4

III. Interaction (Main X Sub-treatments):

Sub-treatments	Main treatments -% germination(Av. values)				
	1	2	3	4	5
Cabbage	98.0	93.0	97.0	96.0	98.0
Lettuce	90.5	100.0	93.0	99.0	100.0
Tomato	51.0	48.5	21.5	39.0	0.0
Eggplant	0.0	0.0	0.0	0.0	0.0
Pepper	0.0	0.0	0.0	0.0	0.0
L.S.D.at 5% level.			7.4		
L.S.D. at 1% level.			9.9		

TABLE III

THE EFFECT OF MEDIA ON GERMINATION OF VEGETABLE SEEDS:
(OBSERVED 9 DAYS AFTER SOWING)

I. Main treatments:

Treatment No.	Treatments (media)	% Germination (Av. values)
1	Soil + Sand + Compost 1:1:1	62.5
2	Peat-Perlite + U. C. mix	58.2
3	Peat-Perlite + Texas mix	50.5
4	Peat-Perlite + Hyponex	58.3
5	Perlite	41.0
	L.S.D. at 5% level	5.4
	L.S.D. at 1% level	7.7

II. Sub-treatments:

Treatment No.	Treatments (vegetables)	% Germination (Av. values)
1	Cabbage	99.5
2	Lettuce	100.0
3	Tomato	56.1
4	Eggplant	14.9
5	Pepper	0.0
	L.S.D. at 5% level	5.5
	L.S.D. at 1% level	7.9

III. Interaction (Main Sub-treatments):

Sub treatments	Main Treatments - % germination (Av.values)				
	1	2	3	4	5
Cabbage	100.0	97.5	100.0	100.0	100.0
Lettuce	100.00	100.0	100.0	100.0	100.0
Tomato	73.0	79.5	48.0	75.0	5.0
Eggplant	39.5	14.0	4.5	16.5	0.0
Pepper	0.0	0.0	0.0	0.0	0.0
	L. S. D. at 5% level		12.4		
	L. S. D at 1% level		17.7		

TABLE IV

THE EFFECT OF MEDIA ON GERMINATION OF VEGETABLE SEEDS:
(OBSERVED 12 DAYS AFTER SOWING)

I. Main Treatments:

Treatment No.	Treatments (media)	% Germination (Av. values
1	Soil + Sand + Compost 1:1:1	85.8
2	Peat-Perlite + U. C. mix	81.7
3	Peat-Perlite + Texas mix	78.7
4	Peat-Perlite + Hyponex	78.1
5	Perlite	65.1
	L. S.D. at 5 % level	3.6
	L. S.D. at 1 % level	5.1

II. Sub-treatments:

Treatment No.	Treatment (vegetables)	% Germination (Av. values)
1	Cabbage	100.0
2	Lettuce	100.0
3	Tomato	99.5
4	Eggplant	80.9
5	Pepper	9.0
	L.S.D. at 5 % level	4.7
	L.S.D. at 1 % level	6.7

III. Interaction (Main X Sub-treatments):

Sub-treatments	Main treatments - % germination (Av.values) 1	2	3	4	5
Cabbage	100.0	100.0	100.0	100.0	100.0
Lettuce	100.0	100.0	100.0	100.0	100.0
Tomato	100.0	100.0	97.5	100.0	100.0
Eggplant	100.0	97.0	93.5	88.5	25.5
Pepper	29.0	11.5	2.5	2.0	0.0
	L.S.D. at 5 % level	11.5			
	L.S.D. at 1 % level	14.9			

III. EFFECT OF MEDIA ON THE DRY WEIGHT OF SEEDLINGS

Five seedlings each of cabbage and lettuce from the various treatments in all the replication were pulled, and the seedlings were cut separating the roots and tops and their fresh and dry weights recorded. The results of the data that was statistically analysed is presented in Table V. They show no significant difference between cabbage and lettuce in dry weight of either tops or roots.

When considered at the 5 percent level of probability the media peat-perlite plus Hyponex (T_4) and perlite alone (T_5) produced maximum dry weight of plants raised in them. Between the rest of the media there was no significant difference in the percentage of dry weight produced although peat-perlite Texas mix was superior to soil, sand and compost.

In both cabbage and lettuce the roots possessed more dry weight than did the tops, the proportion being in the order 2:1.

None of the interactions were significant at the 5 percent level.

IV. STUDIES ON THE GROWTH OF BANDED SEEDLINGS GERMINATED IN DIFFERENT MEDIA

The seedlings germinated in the various media and which were pricked into a uniform potting media of soil and compost (3:1), were removed from the bands between 40-45 days after pricking, measurements on the height, spread, fresh weight and thickness of stem of five plants for each vegetable were recorded. The data was subjected to analysis of variance and the results are present in Tables VI to X.

Cabbage. Results presented in Table VI show that the peat-perlite Texas Mix (T_3) was superior as a seeding medium in producing increased height and fresh weight of plants after potting. Plate 2 depicts these plants.

Lettuce. Results presented in Table VII show that, the soil, sand and compost (T_1) was superior in producing increased height and spread of lettuce. Peat-perlite Texas mix and the peat-perlite Hyponex mix produce plants whose fresh weights were not significantly different. Plate 3 depicts these plants.

Tomato. Results presented in Table VIII show that, the soil, sand and compost (T_1), Peat-perlite U. C. mix (T_2) and peat-perlite Texas mix (T_3) were superior to the rest of the treatments in producing increased height in plants. In producing increased stem thickness, the treatment with soil, sand and compost(T_1) was superior to the rest of the treatments. In producing fresh weight, the peat-perlite Texas mix (T_3) was equal to peat-perlite U. C. mix. The perlite medium was inferior. Plate 4 depicts these plants.

Eggplant. Results in Table IX indicated that peat-perlite U. C. mix (T_2) and pure perlite (T_5) were significantly inferior to the rest of the treatments in producing increased plant height, however, there is no significant difference in the fresh weight of plants. Plate 5 depicts these plants.

Pepper. The mean values for height and fresh weight are presented in Table X. The soil, sand and compost (T_1) and the peat-perlite Texas

TABLE V

THE EFFECT OF MEDIA ON THE DRY WEIGHT OF CABBAGE AND LETTUCE SEEDLINGS (TOPS & ROOTS)

I. Main treatment:

Treatment No.	Treatments	Mean value of Dry Weight (%)
1	Cabbage	11.43
2	Lettuce	10.56
	L.S.D. at 5 % level	N.S.

II. Sub-treatment:

Treatment No.	Treatments	Mean values of Dry Weight (%)
1	Soil + Sand + Compost (1:1:1)	7.90
2	Peat-perlite (1:1) + U.C. mix	8.73
3	Peat-perlite (1:1) + Texas mix	10.85
4	Peat-perlite (1:1) + Hyponex	12.91
5	Perlite	14.58
	L.S.D.at 5 % level	3.21
	L.S.D.at 1 % level	4.35

III. Sub-sub treatments:

Treatment No.	Treatments	Mean values of Dry Weight (%)
1	Tops	7.11
2	Roots	14.89
	L.S.D. at 5 % level	1.56
	L.S.D. at 1 % level	2.10

IV. Interactions:
(a) Main X Sub-treatment .... N.S.
(b) Main X Sub-sub treatment ...... N.S.
(c) Sub-treatment X Sub-sub treatment N.S.
(d) Main X Sub-treatment X Sub-sub treatment .... N.S

TABLE VI

CABBAGE: THE EFFECT OF SEEDING MEDIA ON THE HEIGHT AND FRESH WEIGHT OF PLANTS GROWN IN A UNIFORM POTTING MEDIA*

Treatment No.	Treatments (media)	Mean of 5 plants(45 days after potting)	
		Height in Cms	Fresh weight in Grams
1	Soil + Sand + Compost 1:1:1	28.4	72.75
2	Peat-perlite + U.C. mix	28.2	70.00
3	Peat-perlite + Texas mix	33.6	114.75
4	Peat-perlite + Hyponex	24.8	53.50
5	Perlite	19.6	30.75
	L. S. D. at 5 % level	0.7	40.20
	L. S. D. at 1 % level	1.0	56.37

*Soil + Compost (3:1)

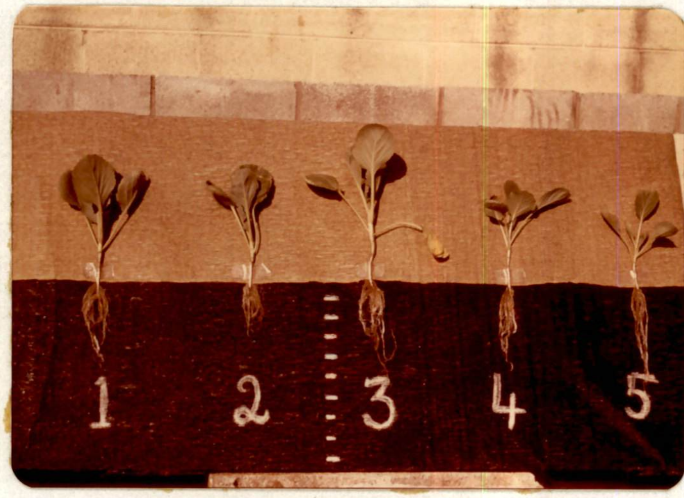

PLATE 2

Cabbage - Effect of seeding media on development (45 days) after potting

1. Soil + sand + compost; 2. Peat-perlite + U.C. mix;

3. Peat-perlite + Texas Mix; 4. Peat-perlite + Hyponex

5. Perlite

TABLE VII

LETTUCE: THE EFFECT OF SEEDING MEDIA ON THE HEIGHT, FRESH WEIGHT AND SPREAD OF PLANTS GROWN IN A UNIFORM POTTING MEDIA*

Treatment No.	Treatments (media)	Mean of 5 plants (45 days after potting)		
		Height In Cms	Fresh weight in Grams	Spread in Cms.
1	Soil + Sand + Compost 1:1:1	43.2	62.25	43.4
2.	Peat-perlite + U.C. mix	39.2	60.25	38.2
3.	Peat-perlite + Texas mix	38.8	86.25	38.2
4.	Peat-perlite + Hyponex	37.6	74.50	35.4
5.	Perlite	25.4	46.25	21.6
	L.S.D. at 5 % level	0.6	21.70	0.5
	L.S.D. at 1% level	0.8	30.43	0.7

* Soil + Compost (3:1).

TABLE VIII

TOMATO: THE EFFECT OF SEEDING MEDIA ON THE THICKNESS OF STEM HEIGHT AND FRESH WEIGHT OF PLANTS GROWN IN A UNIFORM POTTING MEDIA*

Treatment No.	Treatments	Mean of 5 plants(40 days after potting		
		Height in Cms	Fresh weight in Grams.	Thickness of Stem in cms.
1.	Soil+Sand+Compost 1:1:1	15.35	97.50	25.4
2.	Peat-perlite + U.C. mix	14.65	111.50	21.4
3.	Peat-perlite+ Texas mix	15.65	123.00	24.8
4.	Peat-Perlite + Hyponex	13.85	85.75	17.2
5.	Perlite	9.45	30.50	13.2
	L.S.D. at 5 % level	1.08	18.00	0.6
	L.S.D. at 1 % level	1.52	25.24	0.8

* Soil + Compost (3:1).

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TABLE IX

EGGPLANT: THE EFFECT OF SEEDING MEDIA ON THE HEIGHT AND FRESH WEIGHT OF PLANTS GROWN IN A UNIFORM POTTING MEDIA*

Treatment No.	Treatments	Mean of 5 plants (40 days after potting	
		Height in Cms.	Fresh weight in Grams
1	Soil + Sand + Compost 1:1:1	76.0	82.75
2	Peat-Perlite + U.C. Mix	58.6	76.50
3	Peat-Perlite + Texas Mix	70.4	60.75
4	Peat-Perlite + Hyponex	72.4	60.50
5	Perlite	50.8	30.50
	L.S.D. at 5 % level	3.6	N.S .
	L.S.D. at 1 % level	N.S.	N.S.

* Soil + Compost (3:1).

TABLE X

PEPPER: THE EFFECT OF SEEDING MEDIA ON THE HEIGHT AND FRESH WEIGHT OF PLANTS GROWN IN A UNIFORM POTTING MEDIA*

Treatment No.	Treatments	Mean of 5 plants (40 days after potting)	
		Height in Cms	Fresh weight in Grams
1.	Soil + Sand + Compost 1:1:1	71.0	73.75
2.	Peat-perlite + U.C. mix	54.5	58.25
3.	Peat-perlite + Texas mix	69.8	53.75
4.	Peat-perlite + Hyponex	57.0	34.00
5.	Perlite	51.0	30.25
	L.S.D. at 5 % level	2.4	17.72
	L.S.D. at 1 % level	3.4	24.84

* Soil + Compost (3:1).

CRANE'S CREST

mix (T_3) were superior when height of plants produced were considered. The media containing peat-perlite Hyponex, and the perlite alone (T_5) were significantly inferior to the rest of the treatments in producing increased fresh weight in plants. Plate 6 depicts these plants.

V. FIELD STUDIES OF SEEDLINGS GROWN IN DIFFERENT POTTING MEDIA

Seedlings banded in different potting media were field set and observations made as to influence on growth, flowering and fruiting of the vegetables tested. The results are presented in Tables XII to XVII.

Before field setting a visual rating on the general appearance of the plants were made as shown in Table XI. The data show that plants in the soil-compost (3:1) medium were excellent and were closely followed by those produced in the peat-perlite Texas mix.

a) Yield performance: The effect of potting media on yield and percentage of heads and plants maturing in cabbage and lettuce respectiveley were studied.

Cabbage. The results are reported in Table XII. As regards the average number of heads maturing, plants from the soil-compost, and peat-perlite Texas mix produced a significantly greater number of matured heads than other treatments. But considering the effect of media on the yield in pounds, the peat-perlite Hyponex was the only treatment that was significantly lower.

Lettuce. Results presented in Table XIII indicate that the peat-perlite U.C. mix and the soil-compost media are superior in bringing

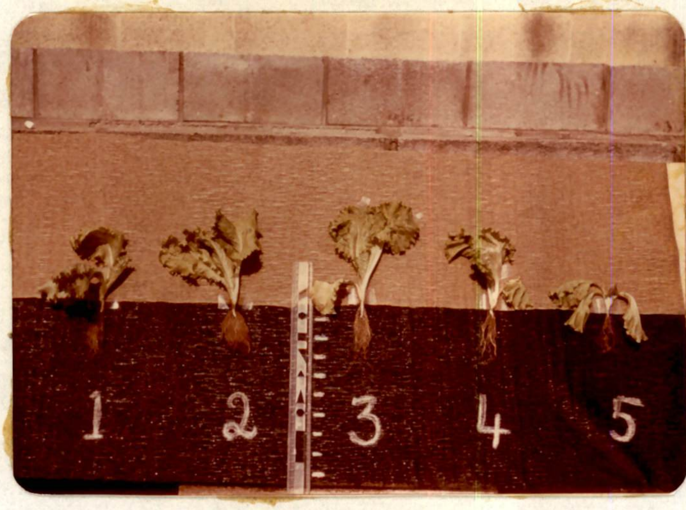

PLATE 3

Lettuce - Effect of seeding media on development 45 days after potting

1. Soil + Sand + Compost; 2. Peat-perlite + U.C. mix; 3. Peat-perlite + Texas mix; 4. Peat-perlite + Hyponex; 5. Perlite

PLATE 4

Tomato - Effect of seeding media on development (40 days) after potting

1. Soil + sand + compost; 2. Peat-perlite + U.C. mix; 3. Peat-perlite + Texas mix; 4. Peat-perlite + Hyponex; 5. Perlite

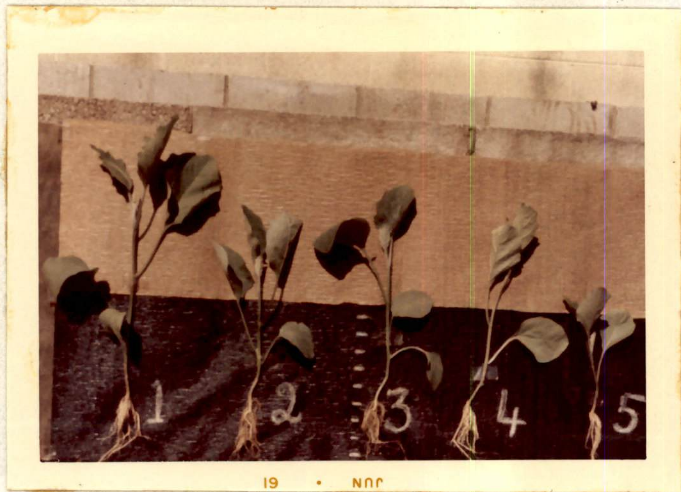

PLATE 5

Eggplant - Effect of seeding media on development (40 days) after potting

1. Soil + sand + compost; 2. Peat-perlite + U.C. mix; 3. Peat-perlite + Texas mix; 4. Peat-perlite + Hyponex; 5. Perlite

PLATE 6

Pepper - Effect of seeding media on development (42 days) after potting

1. Soil + sand + compost; 2. Peat-perlite + U.C. mix; 3. Peat-perlite + Texas mix; 4. Peat-perlite + Hyponex; 5. Perlite

TABLE XI

GROWTH RATING OF SEEDLINGS RAISED IN VARIOUS POTTING MEDIA PRIOR TO FIELD SETTING *

Treatment No.	Treatments (media)	Visual Rating				
		Cabbage	Lettuce	Tomato	Eggplant	Pepper
1.	Soil+Compost 3:1	5	5	5	5	5
2.	Peat-Perlite+U.C. mix	3	4	4	3	4
3.	Peat-Perlite+Texas Mix	4	4	4	4	4
4.	Peat-Perlite + Hyponex	1	2	2	1	1

* 5 - Excellent
4 - Very good
3 - good
2 - Fair
1 - Poor

TABLE XII

CABBAGE: THE EFFECT OF POTTING MEDIA ON THE YIELD AND PERCENTAGE OF PLANTS FORMING HEADS (HARVESTED 60 DAYS AFTER FIELD SET)

Treatment No.	Treatments (media)	Mean values	
		Yield in lbs.	% plants forming heads
1.	Soil + Compost (3:1)	26.0	96.0
2.	Peat-Perlite + U.C. mix	22.2	82.0
3.	Peat-Perlite + Texas mix	25.8	98.0
4.	Peat-Perlite + Hyponex	17.2	82.0
	L.S.D. at 5 % level	4.9	11.0
	L.S.D. at 1 % level	6.1	15.0

TABLE XIII

LETTUCE: THE EFFECT OF POTTING MEDIA ON THE YIELD AND PERCENTAGE OF PLANTS MATURING (HARVESTED 50 DAYS AFTER FIELD SET)

Treatment No.	Treatments (media)	Mean values	
		Yield in ozs.	% plants maturing
1.	Soil+ Compost (3:1)	68.88	94.0
2.	Peat-Perlite+U.C. mix	56.00	84.0
3.	Peat-Perlite+Texas mix	41.60	66.0
4.	Peat-Perlite+ Hyponex	16.00	50.0
	L.S.D. at 5 % level	23.45	24.0
	L.S.D. at 1 % level	32.88	34.0

TABLE XIV

TOMATO: THE EFFECT OF POTTING MEDIA ON THE FORMATION OF EARLY FRUITS & SECOND FLOWER CLUSTER

Treatment No.	Treatment (media)	Mean values: % plants Fruiting	Mean values: Number of fruits on 10 plants	Mean values: % plants with second cluster
		32 days after field set	40 days after field set	32 days after field set
1.	Soil + Compost(3:1)	92.0	41.6	100.0
2.	Peat-Perlite+U.C. mix	38.0	36.2	38.0
3.	Peat-Perlite+Texas mix	46.0	30.0	42.0
4.	Peat-Perlite+Hyponex	0.0	14.8	0.0
	L.S.D. at 5 % level	51.0	7.5	18.0
	L.S.D. at 1 % level	7.0	10.5	25.0

TABLE XV

TOMATO: THE EFFECT OF POTTING MEDIA ON LATERAL SHOOT DEVELOPMENT
(24 DAYS AFTER FIELD SET)

Treatment No.	Treatment (media)	Av. number of * plants pruned
1.	Soil + Compost (3:1)	9.6
2.	Peat-Perlite + U.C. mix	5.4
3.	Peat-Perlite + Texas mix	5.8
4.	Peat-Perlite + Hyponex	0.0
	L.S.D. at 5 % level	2.8
	L.S.D. at 1 % level	3.9

* When second lateral below the infloresence reached 1" in length.

TABLE XVI

EGGPLANT: THE EFFECT OF POTTING MEDIA ON FLOWER AND FRUIT PRODUCTION

Treatment No.	Treatments (media)	Mean values: Flowers observed on 10 plants 47 days after field set	Mean values: Fruits formed on 10 plants 62 days after field set
1.	Soil + compost (3:1)	2.2	4.4
2.	Peat-Perlite + U.C. mix	0.2	2.8
3.	Peat-Perlite + Texas mix	1.6	3.2
4.	Peat-Perlite + Hyponex	0.0	2.0
	L.S.D. at 5% level	1.3	N.S.
	L.S.D at 1% level		N.S.

TABLE XVII

PEPPER: THE EFFECT OF POTTING MEDIA ON EARLINESS OF FRUITING

Treatment No.	Treatments (media)	Mean values: Number of fruits formed in ten plants, 54 days after field set	Mean values: Number of fruits formed in ten plants, 60 days after field set
1.	Soil + Compost (3:1)	3.8	26.8
2.	Peat-Perlite + U.C. mix	0.2	29.8
3.	Peat-Perlite + Texas mix	0.2	21.0
4.	Peat-Perlite + Hyponex	0.0	4.6
	L.S.D. at 5% level	1.3	9.9
	L.S.D. at 1% level	1.8	13.9

about increased yield and increased number of plants to maturity, although the peat-perlite Texas mix was satisfactory.

b) Growth performance: Tomato: The effect of potting media on lateral shoot development, formation of early fruits, the number of fruits formed in the first cluster, and the development of the second flower cluster were studied. The results are presented in Tables XIV and XV.

The results presented in Table XIV show that the soil-compost medium is equal to the peat-perlite Texas media in influencing the production of early fruits while it is superior to the rest in influencing the second flower cluster. Considering the number of fruits produced in the first cluster of plants raised in the different media, soil-compost was equal to peat-perlite U.C. mix but superior, to the rest. The results in regard to the effect of media on lateral shoot development presented in Table XV, indicate that the soil-compost medium is superior in producing lateral shoot development which can be considered a measure of rapid plant development.

Eggplant. Studies made on the effect of potting media on flower and fruit development are present in Table XVI. The results indicate that plants grown in soil-compost and peat-perlite Texas mix are superior to those in other media in producing early flowering, but no significant effects of the various media were observed in regard to fruit development.

Pepper. The effects of potting media on earliness of fruit production are furnished in Table XVII. The results show that peat-perlite Hyponex is inferior to the rest of the media in influencing fruiting 60 days after field set, while the soil-compost medium was superior to the rest of the media in influencing fruiting 54 days after field setting.

CHAPTER V

DISCUSSION OF RESULTS

I. MEDIA

All the peat-perlite media had low pH's. Amongst these the peat-perlite U.C. mix and peat-perlite Texas mix had high levels of nitrate nitrogen. The level of nitrate nitrogen in peat-perlite Texas mix of 75 ppm is not favorable for the growth of vegetable seedlings as seen from the report by Hibbard and Lambeth (20) . But as can be seen from the succeeding portions of this report, the peat-perlite U.C. mix and peat-perlite Texas mix were satisfactory media for raising plants. This was perhaps due to the fact that the physical characteristics of perlite provided ample drainage and did not become soggy even when overwatered enabling the injurious salts to be leached out.

II. GERMINATION OF SEED AND DRY WEIGHT OF SEEDLINGS

In this study, media had no influence on earliness of germination. The findings are in line with the normal periods required for germination of the various vegetables, except that eggplants emerged earlier than peppers perhaps due to the fact that the pepper seed used were old.

Considering the effect of media on percentage germination of seeds 8 and 9 days after sowing indications were that peat-perlite Texas mix and perlite were inferior types of media compared to the others. This may be due to the fact, that the total quantity of salts of nitrogen and potash were approximately 1.06 grams per flat in peat-perlite Texas mix compared to 0.10 grams and 0.09 grams in the peat-perlite U.C. mix and peat-perlite Hyponex respectively, while in the perlite medium the nutrient being as low as 1ppm of nitrate nitrogen was inadequate for plant growth. Twelve days after sowing when germination counts were again taken those in the medium which contained perlite alone were poor and those from the soil, sand and compost were found to be the best, while those from the peat-perlite U. C. mix and peat-perlite Hyponex were satisfactory.

Considering the effects of the main treatments, the overall average values of the percentage dry weight show that there is no difference in either cabbage or lettuce when the combined effects of sub-treatments (media) and sub-sub treatments (tops and roots) are considered together.

The results presented in Table V relating to cabbage and lettuce seedlings raised in different media indicate that the interaction effects between the vegetables, media and dry weight of tops and roots were not significant at the 5 percent level.

The percentage dry matter in seedlings was highest in those raised in the peat-perlite Hyponex and perlite media. The percentage of dry weight produced by plants in the peat-perlite Texas mix and peat-perlite Hyponex were not significantly different. Further, there was no significant difference in the percentage of dry weight produced by seedlings raised in the soil, sand and compost, peat-perlite U.C. mix and peat perlite Texas media. The seedlings raised in the peat-perlite combinations produced a large fiborous root system. Morrisson et al. (33) lend support to this observation, reporting that as perlite has a good balance between water holding capacity and aeration a good root system is produced.

The increase in dry weight of roots, brings about a low top-root ratio, and low top-root ratio is generally associated with plants raised at a low moisture status as reported by Meyer and Anderson (31). Conrad and Veihmeyer (8) reason, that if the soil is wet at the beginning of the growing season to the full depth to which root of plants will normally penetrate, subsequent additions of moisture under normal conditions, can have but little influence on the extent of the root system produced. In this experiment seedlings in peat-perlite Hyponex and perlite media had the highest percent of dry weight being composed mainly of the roots. These two media produce therefore a low top-root ratio, but it cannot be said that this media possessed a low moisture content, since peat is found to absorb 10 to 30 times its weight in water (10), and perlite has a water holding capacity of 300-400 percent (27).

The reasoning of Conrad and Veihmeyer seems true in this case. The peat-perlite Hyponex or perlite alone had little or no nutrients compared to the rest of the media. The seedlings in both these media were stunted and looked less vigorous and unhealthy.

III. EFFECT OF SEEDING MEDIA ON RECOVERY AND DEVELOPMENT OF PLANTS

The height, fresh weight, spread and thickness of stem of the different vegetable plants raised in a uniform potting media of soil-compost (3:1) after being started in the various seeding media is presented in Tables VI to X.

Considering the height of cabbage plants, those started in peat-perlite Texas mix were significantly superior to that from other media, while perlite alone produced the shortest plants. Lettuce plants from the soil, sand and compost were significantly taller than those in other media, while perlite produced shortest plants.

For tomato, peat-perlite Texas mix, soil, sand and compost and peat-perlite U. C. mix produced the tallest plants, and perlite produced the shortest plants. Plants of eggplants started in soil, sand and compost medium were significantly taller while those from peat-perlite U. C. mix and perlite less tall. Pepper plants from soil, sand and compost and peat perlite Texas mix were taller than those started in other media.

Cabbage plants started in the peat-perlite Texas mix produced a significantly greater fresh weight than those from other media. Plants started in the soil, sand and compost, peat-perlite U. C. mix and peat-perlite Hyponex were not significantly different. Plants started in perlite alone were not significantly different from those started in peat-perlite U. C. mix and peat-perlite Hyponex but weighed less than the second group. Lettuce plants started in peat-perlite Texas mix were equal to those from the peat-perlite Hyponex mix, but larger than those from the other media. Tomato plants started in peat-perlite Texas mix were equal to those from the peat-perlite U. C. mix and larger than those from the other media. Plants in the perlite medium produced the least fresh weight. The fresh weight of eggplant seedlings was not modified by any medium used.

Pepper plants started in soil, sand and compost were equal to those from the peat-perlite U. C. mix but produced larger plants than those from the other media. Peat-perlite Hyponex and perlite alone produced least fresh weight.

The spread of plants and thickness of stem of the lettuce and tomato respectively were the best from the soil, sand and compost medium.

The discussion in the preceding paragraphs indicates, that plants that are vigorous in the seedling stages perform better than weak seedlings when potted in a desireable medium at optimum spacing. Those that have a poor initial start do not improve in the majority of cases, as the plants that were started in the perlite medium continued to do poorly. This may be due to the cells of the weak plants being less active and unable to recuperate even when placed in a better environment. When all factors of plant recovery were considered those seeded in soil, sand and compost and the peat-perlite Texas mix were the best. The peat-perlite Texas mix besides producing vigorous and healthy plants also had the added advantage that seedlings could remain a few days longer before transplanting in this seeding media without losing their vigor and health and still produce acceptable plants. This finding is in agreement with the observation made by

Morrisson (32). He found that a succession of quick maturing crops like lettuce can be obtained from a single sowing by pricking from the germination flats only as many seedlings as are required each time.

A general observation of the plants in the various media a month after sowing showed that those in soil, sand and compost, and the peat-perlite U.C. mix which had beeen vigorous in growth during the early stage were turning yellow and looked less healthy. Seedlings in peat-perlite Hyponex and perlite alone were stunted, looked weak, unhealthy and chlorotic. Seadlings in the peat-perlite Texas mix looked much healthier and greener in color compared to the seedlings in the soil, sand and compost medium.

IV. POTTING MEDIA AND ITS EFFECTS ON PLANT GROWTH IN THE FIELD

The banded plants raised in the different potting media prior to field setting were visually rated as to vigor and health at time of planting. The results of this rating presented in Table XI indicate that the plants of all vegetables grown in the soil-compost medium (3:1) were excellent, being closely followed by those grown in the peat-perlite Texas medium.

This observation is in agreement with the results obtained in regard to the height of seedlings started in different seeding media discussed earlier.

The observations on the yield, number of heads and plants maturing, production of flowers and fruits in the various vegetables are presented in Tables XII to XVII.

Cabbage yields were not influenced by the potting media, except in the peat-perlite Hyponex grown plants, where the yields were significantly lower. Considering the effect of media on the number of heads maturing, the soil-compost and the peat-perlite Texas mix were decidedly superior under the conditions of the trial.

Lettuce yields are more or less in line with those of cabbage The peat-perlite Hyponex was an inferior medium, no difference in yield were found due to the other treatments. Media had very little effect on the number of plants maturing except peat-perlite Hyponex media produced fewer bunches of lettuce.

Considering the effect of media on lateral shoot development, early fruiting and the formation of second flower cluster in tomato, plants grown in the soil-compost mix was superior to those in other media in producing lateral shoot development and in formation of second flower clusters, and was equal to those from the peat-perlite Texas mix in its effect on early fruiting. This finding is in agreement with earlier work by Honma (22) where he reported that, for early tomato yields the use of soil as a medium favored larger earlier yields. When the number of fruits borne in the first cluster, were considered plants from the peat-perlite Hyponex medium were inferior, while those from the soil-compost and peat-perlite U.C. mix were equal in their influence, but, soil-compost was significantly superior to peat-perlite Texas mix which was equal to peat-perlite U. C. mix in its influence on fruit formation.

In eggplants, the media had no effect on early fruiting, but observations made on the effect of media on flower formation indicated, that peat-perlite U.C. mix and peat-perlite Hyponex were both inferior media not being different amongst themselves.

First observation in regard to early fruit formation in pepper indicated that plants from the soil-compost was superior to the others, A week later when fruits had set on plants produced in other media, it was observed that with the exception of the peat-perlite Hyponex where the fruiting was poor, in rest of the media their influence on fruiting were equal.

Peat-perlite Hyponex and perlite alone were generally poor as a seeding media, and as a potting media, peat-perlite Hyponex was inferior to the rest of the media under the conditions that existed during these experiments. It may be possible that the two poorer media could be improved by correct fertilization.

Results indicate that inorganic materials such as perlite if properly compounded with organic material like peat moss and properly supplied with mineral nutrients can be used as effectively as soil as a medium for growing vegetable plants. Table XVIII shows soil to be the cheapest among the media tried, yet the factors like availability, cost of handling, cost of sterilization and the problems both physical and chemical that are involved with soil may make the use of soil substitute desirable.

TABLE XVIII

COMPARATIVE COST OF SEEDING AND POTTING MEDIA PER CUBIC YARD

Media	Soil	Sand	Compost	Sphagnum Peat Moss	Horticultural Perlite #8	Basic Fertiliser	Mixing and Sterilizing	Approximate Total Cost $
Soil+ Sand+ Compost (1:1:1)	9 cu.ft $1.00	9 cu.ft 66¢	9 cu.ft $3.00				21¢	4.87
Soil+ Compost (3:1)	20.25 cu.ft $2.25		6.75 cu.ft. $ 2.25				21¢	4.71
Peat-Perlite+ U.C. mix				13.5 cu.ft. $3.50	13.5 cu.ft. $5.50	20¢ x	21¢	9.41
Peat-Perlite+ Texas mix				13.5 cu.ft. $3.50	13.5 cu.ft. $5.50	20¢ xx	21¢	9.41
Peat-Perlite+ Hyponex				13.5 cu.ft. $3.50	13.5 cu.ft. $5.50	34¢	21¢	9.55
Perlite					27.0 cu. ft. $11.00		21¢	11.21

x From California Agr. Exp Sta. Ext. Ser. Manual 23.
xx From Texas Agr. Exp. Sta. Misc. Pub. 420

CHAPTER VI

SUMMARY AND CONCLUSIONS

Five seeding and four potting media were studied with respect to their effect on germination, plant growth and development in the field of cabbage, lettuce, tomato, eggplant and pepper. Under the conditions of the experiment the results indicate:

1. A significantly higher rate of germination of all vegetables tested was attained in the soil, sand and compost medium, but the germination in the peat-perlite U. C. mix, peat-perlite Texas mix and the peat-perlite Hyponex was satisfactory. Perlite alone produced maximum percentage of dry weight in plants though it was not different from peat-perlite Hyponex. Roots contained a higher percentage of dry weight than tops.

2. Studies on recovery and development of the seedlings sown in various media and potted in a uniform soil-compost (3:1) revealed that, when all factors of plant recovery were considered those from soil, sand and compost and peat-perlite Texas mix were best.

3. Studies of the effect of potting media on plant growth in the field indicated that earliness of flowering and fruiting in tomato, eggplant and pepper were obtained in seedlings potted in the soil-compost medium.

4. Considering total yields in cabbage and lettuce the peat-perlite Texas mix and peat-perlite U. C. mix were equal to the soil-compost medium.

The results of the investigation reveal the possibility of the effective use of inorganic materials such as perlite if properly compounded with organic material like peat moss and adequately fertilized can serve as an effective substitute for soil as medium for growing plants. Though soil medium is the cheapest of the media tried, yet the availability, handling and sterilization costs and problems such as soil borne diseases, weeds, salinity and toxicity that are involved with soil may make use of a substitute for soil necessary.

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