The Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

Vol. XXXVII October 1950 No. 10

Editorial.

A notable event during the month was the inauguration of the Central Food Technological Research Institute at Mysore by Hon'ble Sri C. Rajagopalachari. This Institute is one of the eleven national laboratories established under the auspices of the Council of Scientific and Industrial Research and is located in the Cheluvamba Mansions, a munificent gift by the Maharajah of Mysore and marks the first big step which the Government of India have taken to solve the food problem from the technological as distinguished from the purely biological methods. As Dr. Bhatnagar pointed out in his speech, the trade in food materials has in recent years formed such an important feature of India's imports and exports, involving the stupendous sum of 225 to 240 crores of rupees, that it was felt imperative to have the assistance of an up-to-date technological institute to meet the needs of our people in supplementing the biological aspects that are the concern of Agricultural Research Institutes.

As it is, we are now importing at a heavy charge, very large quantities of food grains from foreign countries and also giving a subsidy from the Central revenues to the consumers of such imported food grains. Obviously this cannot go on indefinitely; and to attain self-sufficiency in this matter of food as speedily as possible, it is obviously the duty of every one to put forth the best effort to intensify production. The main lines are, by bringing fresh areas under cultivation, by increasing yields in existing areas by greater attention, better management and more liberal manuring and by minimising waste, during transit and storage. Other things that can help in the direction of utilising the available food resources to the best advantage are, the preservation of food without deterioration, so as to be available for use when needed, the scientific application of known technological processes, for reducing waste and spoilage, by dehydration and other methods of hygienic preservation, elimination of harmful constituents of non-edible materials and thereby making them edible; these are some of the aspects that this Technological Inistute is expected to tackle. As Sri C. Rajagopalachari, remarked in the course of his address, "why should man, with all the Science available to him relegate grass and leaves to the realm of inedible things?" The Institute will also investigate the possiblities of evolving suitable methods for the fortification of foods, in the production of supplementary foods and dietetic accessories. Another activity of the Institute will be food engineering. in order to devise better ways of processing and utilising foodstuffs so as to take the best out of them for our aliment.

All problems of research require, in the words of Sri C. Rajagopalachari a close and high-level scientific ivestigation and those relating to food problems require it to even a higher degree. Success no doubt depends on chance, for ultimately scientific discovery is a game of chance, though based on thorough equipment and whole-hearted endeavour. Success is also conditioned by the quality of the men who make the search for the right solution, a search which might be likened to the proverbial one for a needle in a haystack. This, the men of science might say, depends in turn, on the encouragement the men of science receive from the democracy that is in charge of the country. In other words the utility and efficacy of knowledge depends on the amount of patronage, knowledge receives from ignorance!

In the present instance however, this patronage has really been on a munificent scale, so far as the eleven national laboratories are concerned and it is now up to the men of science to show what they can do, to alleviate the food shortage and aid in attaining self-sufficiency in food. As the Prime Minister Pandit Nehru, observed in his message on the occasion, we have talked during the last few years more about food than perhaps anything else.

"We have put up, thanks to the tremendous drive and energy of Dr. Bhatnagar, some magnificent labroratories, not only impressive to look at, but I hope, the homes of productive effort and work. So far we have depended for our scientific advancementon other countries and have merely copied them or taken advantage of something that they have done in their countries. We cannot go far with this dependence. *We have at least laid good and true foundations for scientific* progress. It is for the young men and scientists of India to take advantage of the great opportunities offered to them and thereby help in building up the new India."

In this context, the following parable of the pile of sticks quoted from A. G. Street is worth bearing in mind, as it illustrates forcibly that though such magnificent institutes are no doubt achievements to be proud of, still they are only half the battle, and the more important half can only come from within.

A white man was travelling in Africa, through the chimpanzee country and every so often, came across a pile of sticks. These were *built up in the form of a* fire; small sticks in the centre, then the next size and lastly the larger ones on the outside, a real boyscout job of work. He passed so many that he asked the negro bearer who was accompanying him, who built those fires.

"Chimpanzee. He watch man, he copy. He build fire well, but he no spark to light".

It is up to us to prove hereafter that this essential spark is also there.

Inheritance of Seed-coat colour in Gram

(*Cicer arietinum*)

By

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It was stated in a previous paper by Ramanatha Ayyar and Balasubrahmanyan (1936) that the seed-coat colour Rood's brown corresponding to the seed grade CS 12 was formed by the addition of factor T^1 to CS 10 and that T^1 had no effect when P was absent. The inheritance and interaction of factor T^1 studied further on other genetic backgrounds form the subject-matter of this paper.

Six pure lines of gram whose genic constitutions are already known and given in Table 1 formed the parents of the five crosses made and studied in detail. Crosses between two Pusa types were generally of low productivity and as such failed to give sufficient population in second and third generations while other crosses with local type 19 were generally prolific yielding fairly large populations.

TABLE 1.

Variety	Petal colour	Seed-coat colour	Genic formula
T6	White	CS1	$CbP\ f^r t^1 t^2$
T8	do.	CS2	$CbP\ F^r t^1 t^2$
T10	do.	CS3	$CbP\ f^r t^1 T^2$
T21 T24 19	Pink	CS12	$CBP\ f^r T^1 T^2$

Experimental results:

(a) Pinkish cinnamon (CS 3) $CbP\ f^r\ t^1\ T^2$

×

Rood's brown (CS 12) $CBP\ f^r\ T^1\ T^2$

Two crosses viz., T 10 × T 24 and T 10 × 19 were studied under this group and their segregations are detailed in Table 2.

TABLE 2.

Nature of Cross studied	Generation	No. of families studied	Total nuber of plants	Actual number of plants obtained in CS: Pink flower								White flower								Expected ratio	Value of P greater than
				13	12	11	10	22	21	9	8	20	19	4	3	18	17	2	1		
				$CBPF^rT^1T^2$	$CBPf^rT^1T^2$	$CBPF^rt^1T^2$	$CBPf^rt^1T^2$	$CBPF^rT^1t^2$	$CBPf^rT^1t^2$	$CBPF^rt^1t^2$	$CBPf^rt^1t^2$	$CbPF^rT^1T^2$	$CbPf^rT^1T^2$	$CbPF^rt^1T^2$	$CbPf^rt^1T^2$	$CbPF^rT^1t^2$	$CbPf^rT^1t^2$	$CbPF^rt^1t^2$	$CbPf^rt^1t^2$		
T 10 × 19	F2	5	244		138		48						46		12					9: 3: 3: 1	0·80
T 10 × T 24	F2	2	37		20		7						6		4						0·70
T 6 × 19	F2	10	472		194		74		67		16		74		20		19		8	27:9;9:3:9:3:3:1	0·70
T 8 × 19	F2	4	219	72	26	23	6	25	3	8	1	24	10	10	2	5	1	3		81:27:27:9:27:9;9:3: :27:9:9:3:9:3:3:1	0·80
T 8 × T 21	F2	7	56	16	7	8	3	2	1	2	2	3	3	2	2		1	31			0·04

The parents differed in factors B and T^1 and the observed segregation agreed with an independant di-hybrid ratio. Of the four phenotypes in second generation, CS 12 and CS 3 are parental types and CSs 10 and 19 are new combinations. The genetic constitution of CS 10 already known, (Ramanatha Ayyar and Balasubrahmanyan 1936) and therefore CS 19 should be CbP $f^r T^1 T^2$. The addition of factor T^1 to CS 3 imparts a fawn colour which is styled as CS 19.

(b) Warm buff (CS 1) CbP $f^r t^1 t^2$

×

Rood's brown (CS 12) CBP $f^r T^1 T^2$

The segregation of one cross viz., T 6 × 19 studied up to the second generation is given in Table 2. The number of phenotypes and the observed number of plants in each phenotype agreed very closely with the expected ratio. Seed grades CS 21 and 17 have not been described before and their genic constitutions are easy to fix on account of their differences in petal colour. Pink flower will have factor B while white flower will lack it. It may again be noticed that the genic constitutions of these two new grades differ from CSs 8 and 1 respectively by a single factor T^1.

(c) Pale ochraceous salmon (CS 2) CbP $F^r t^1 t^2$

×

Rood's brown (CS 12) CBP $f^r T^1 T^2$

Two crosses viz., T 8 × 19 and T 8 × T 21 were made and studied. Sixteen phenotypes conforming to a four-factor hypothesis were noticed and the relative observed populations in these classes agreed with the expectations on the basis of independent segregation. Due to smallness of F_2 numbers in T 8 × T 21, the P value was lower than 0 05 but the behaviour in the following F_3 generations was according to the four factor hypothesis. The four new round seeds of grade CSs 13, 22, 20 and 18 should have been formed by the addition of factor T^1 to the old grades CSs 11, 9, 4 and 2 respectively. The available plants were studied in F_3. Figures are not given since their behaviour was as expected. Their genic constitutions and colours as matched with the colour standards of Ridgeway (1912) are given in the following Table 3.

TABLE

Genic constitutions of the new synthesised grades with factor T^1.

Seedgrade	Petal colour	Genic formula	Colour standard
CS17	White	CbP $f^r T^1 t^2$	Vinaceous buff
CS18	do.	CbP $F^r T^1 t^2$	do.
CS19	do.	CbP $f^r T^1 T^2$	Fawn

Seedgrade	Petal colour	Genic formula	Colour standard
CS20	do.	CbP $F^rT^1T^2$	Wood brown
CS21	Pink	CBP $f^rT^1t^2$	Avellaneous
CS22	do.	CBP $F^rT^1t^2$	do.
CS12	do.	CBP $f^rT^1T^2$	Rood's brown
CS13	do.	CBP $F^rT^1T^2$	Vandyke brown

CSs 17 and 18 have the same colour vinaceous buff and similarly CSs 21 and 22 conform to a common colour avellaneous. There is difference in seed shape only. All these four grades lack factor T^2 and it looks as though that the effect of T^1 on the t^2 base is the same within each group irrespective of differences in factor F^r.

There was no linkage between factors T^1-T^2, F^r-T^1, and $B-T^1$.

Discussion: Hukum Singh and Ekbote (1936) suggested three new seed colour factors A, R and D in addition to the two petal colour factors B and P for explaining the results of three crosses studied by them. They stated that (1) factor A had no action on petal colour but imparted a bluish brown seed coat colour, round shape and smooth surface. (2) Factor R modified the action of A by converting the colour to reddish-brown and changing the round shape to irregular. (3) Factor B produced blue petals and had the same kind of action on seed coat as factor A. (4) Factor P converted blue petal to pink when occurring with B and the bluish-brown round seeds were changed to yellowish-brown irregular seeds when in association with B or A. (5) Factor modified the action of P by turning yellowish-brown seeds to dark-reddish-brown colour. The authors added a footnote to [the above hypothesis by stating that if factor P was presumed to produce yellowish-brown independently, the new factor A proposed was not necessary, and it that was retained since the factor P possessed by types T 1, T 2 and T 9 had yellowish-brown seeds.

Their whole scheme of factorial hypothesis was based on the assumption that there were only two petal colour factors B and P under which BP would be pink, Bp blue, bP or bp would be white. It would be therefore impossible to obtain a pink or a blue petal by crossing two whites. It was however, shown by Ramanatha Ayyar and Balasubrahmanyan (1936) that the petal colour in gram was controlled by three factors C, B, P in which C and B were complementary and P supplementary to B. When all these were present together the colour was pink, when CB alone were present it was blue while in six other combinations viz., cbp, Cbp,

cBp, cbP, CbP and cBP it was white. It was also demonstrated in the same paper that factor pair C-c had no effect on seed coat, while B and P had pleiotropic effects. Two factors T^1 and T^2 affected seed coat colour only while factor F^r affected both seed colour and seed surface. The genetic constitutions of the parents and crosses studied by Hukum Singh and Ekbote are given in Table 4.

TABLE 4.

Type	Petal colour	As per Singh and Ekbote			As per Ramanatha Ayyar and Balasubrahmanyan.	
		Shape of seed	Seed colour	Factorial cnstitution	Seed grade	Factorial constitution
T11	White	Round	Bluish brown	Arbpd	CS7	$cBpT^2t^1f^r$
T12	White	Irregular.	Reddish brown	ARbpd	CS10	$cBPT^2t^1f^r$
T52	Pink	do.	Yellowish brown	ArBPd	CS10	$CBPT^2t^1f^r$
T21	Pink	do.	Dark red brown	ArBPD	CS12	$CBPT^2T^1f^r$
T11xT12 F1	White	do.	Yellowish to reddish-brown.	ARbpd	CS10	$cBPT^rt^1f^r$
T11xT52 F1	Pink	do.	Yellowish-brown	ArBPd	CS10	$CBPT^2t^1f^r$
T11xT21 F1	Pink	do.	Dark reddish brown	ArBPD	CS12	$CBPT^2T^1f^r$

The flower colour constitutions of T11 and T12 given as same as per column 5 are not correct as proved by the petal colour segregations noticed in two crosses viz T8 × T11 and T8 × T12 which gave in F2 modified trihybrid ratios of 27: 9: 28: for pink, blue and white petals and dihybrid ratio of 9:7 for pink and white petals respectively as per factorial scheme in column 7. The observed behaviour of the three crosses studied for petal colour and shape character will be the same under both the hypothesis. The Fl of T11 × T12 has been described by Singh and Ekbote as showing a range of variation from reddish-brown to yellowish-brown as also the F_2. If the yellowish and reddish-brown seeds are two different and distinct colour grades governed by different genes, then it is extremely unlikely for the two grades to have occurred in one and the same plant. It is well known that the qualitative and quantitative expression of a factor is often affected by environment but the major effect of the factor is always distinguishable from the smaller effects. All seeds produced on a plant are generally not of the same hue and often variations from yellowish to reddish-brown are present in seed grade CS10. The ultimate grading is usually the result of mass effect of the preponderant tint ignoring the existence of minor colour variations in the same sample. A reasonable allowance must be made for the small variations existing in the seed colour in the produce of same plant and these limits should be invariably taken for fixing the colour range of the particular grade in classifications. The cross T12 × T11 studied by Ramanatha Ayyar and Balasubrahmanyan did not have the identical hue of the standard CS10 but exhibited slight variations in colour too small to be stated as new types. The finer shades of colour when sown separatetly and studied, failed to breed true to the parental grades but behaved alike indicating that slight differences had no genetic significance. The hypothesis developed by Ramanatha Ayyar and Balasubrahmanyan took into consideration the results of nine different crosses covering most of the genetic constitutions and this hypothesis has been found to be adequate for explaining the mode of segregations in later crosses too. The results of seed coat in all the crosses studied by Hukum Singh and Ekbote may therefore be explained on the basis of factors B, P and T only (T^2 being common to all.)

Summary: 1. Factor T^1 is independent of seed grade factor T^2. Eight grades viz., 13, 12, 22, 21, 20, 19, 18 and 17 formed by the addition of the factor T^1 to the old grades CSs 11, 10, 9, 8, 4, 3, 2 and 1 respectively are described.

2. There was no linkage between factor T^1 and T^2 or F^r or B.

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Production of Broad-leaved Suckers in Bananas

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The occurrence of two types of suckers in banana plantations, the sword and the broad-leaved or water suckers is well known. Cook (1911) attributed the development of sword suckers to the growth of buds on the rhizome situated near the surface of the ground. Skutch (1929) says that this "phenomenon is one of apical dominance". Preliminary investigations on the occurrence of broad-leaved suckers were undertaken and materials collected by the excavation of a number of broad-leaved and sword suckers in various stages of development. These reveal in general that broad-leaved suckers arise under any one or more of the following circumstances:—

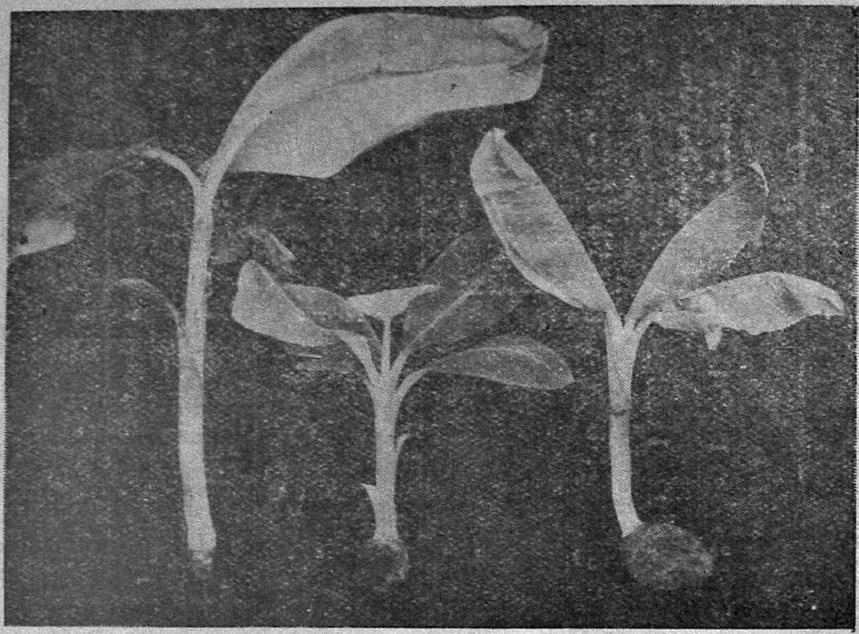
(i) If the bud from which the suckers sprout is small and is attached to the parent corm by a narrow connection. (Vide photographs).

(ii) If the parent corm and tissues surrounding the buds which produce the sucker are diseased.

(iii) If the parent corm or portion of the corm which contains the sprouting bud is injured or cut and separated to small bits or damaged by insects.

(iv) Lack of moisture or ill-drained conditions prevailing in the soil for a sufficiently long period affect the supply of nutrients to the buds. The sprouting of water suckers in banana plantations immediately after the first rains following an acute and prolonged period of drought has been noted. At the Banana Research Station, Aduthurai, in a trial designed to test the efficacy of corms and bits as planting material, 144 corms and 144 bits were planted in a portion of the wet land in January 1950. Due to ill-drained conditions in the field, which continued for a period of over a month after planting, their sprouting was very poor. Only 28 corms and 34 bits sprouted. On examination it was found that all the corms and bits which had not sprouted had become rotten. It was also observed that all the sprouts from the corms and bits were broad-leaved suckers and that portions of all the corms and bits which had sprouted were diseased.

(v) If the banana plantation is too old, over-crowded and shady, not desuckered properly or not manured adequately.



1. Broad-leaved sucker from a small sprouting bud.
2 and 3. Broad-leaved suckers from diseased corms.

These suckers therefore are not at all the normal phenomenon in a healthy banana area. The senior writer did not find even one per cent production of broad-leaved suckers from the sprouting of the corms and bits planted with sufficient size in the pits of commercial banana plantations in Jamaica. It is a recognised practice there to cut the parent corm into two bits each with a good bud, only if the diameter of the corm exceeds 4½ inches and upto 7½ inches. The corms are cut into four if their diameter exceeds 7½ inches. It can therefore be taken that the broad-leaved suckers arise due mainly to environmental factors causing the dislocation of adequate supply of nutrients to certain ill-placed buds in the corm of the mother clump. Even under these circumstances the total number produced is by far smaller than the total number of sword suckers produced.

Excavation studies have shown that the attachment of the sword suckers to the parent corm is closer and firmer and as such the sword sucker in the early stages of its growth draws freely from the reserve food material stored by the mother plant. It builds up a sturdier pseudostem than the broad-leaved sucker. Due to the easy availability of food material from the parent corm, the function of leaves to build up starch is not so essential in the case of a sword sucker as in the case of a broad-leaved sucker and therefore the leaves of the sword sucker are narrow and attain full lamina size only gradually. Due to the weak attachment of the broad-leaved sucker to the parent corm, the availability of food supply to it from that source becomes restricted. This leads to a weak and stunted pseudostem in the early stages and an adaptation to form a broad leaf to build up food material.

The initial growth attained by the sword sucker is recognised by all to be superior to the broad-leaved sucker to such an extent that planters throughout the world take care to eliminate broad-leaved suckers at the time of planting. After some time when both the type of suckers are planted without the parent corm, it is possible that the rate of growth of either may vary being subject to environmental factors also and the broad-leaved sucker may approach or even overtake the growth made by the sword sucker. Such a study, with the ultimate performance of each type of sucker as the main objective is well worth investigation and is now under way at the Central Banana Research Station at Aduthurai.

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Rooting of Cuttings — Part II

Rooting media, depth of planting and basal cut

By

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Introduction: Among the various factors influencing the rooting of cuttings, the rooting medium demands, perhaps, the foremost consideration. No less important are depth of planting and the position of basal cut. A precise knowledge on these aspects will be of practical benefit to a nurseryman dealing with large-scale propagation of fruit and ornamental plants.

Numerous instances have been cited by workers on the variable performance of cuttings of the same species in different media. The more common among the media put to test were sand, pumice, peat, peat moss, peat and soil, fiber, saw-dust charcoal etc. Water has also been tried by some. The results of these studies are not only diverse but are also in some cases inapplicable to conditions obtaining here, so that it seems necessary to conduct independent trials with cuttings commonly met with in our regions, before one can safely make a satisfactory recommendation. The details presented in this paper relate to an observational trial conducted by the author at the College Orchards, Coimbatore, during April – June 1949, to test the efficacy of six different media.

Review of Literature: The salient points of interest in the results in this field of workers may be summarised as follows:

(a) ***Rooting media:*** 1. The choice of medium for soft wood cuttings generally demands special care, whereas hard wood cuttings are more tolerant.

2. The medium requires good aeration.

3. There should be adequate warmth and replenishment of air at the basal end of the cutting.

4. The most successful media for rooting of cuttings are all of open texture.

5. Clean, sharp sand has long been a standard rooting medium for most cuttings because (a) it is easy to obtain and provides good aeration; the chances of getting too wet is reduced, (b) it is devoid of organic matter and of organisms which induce rotting (c) the low moisture content of sand is deemed as one of the reasons for its preference and (d) in experimental work it can most readily be freed from traces of unknown substances that affect root formation.

6. Roots produced in a sandy medium are generally brittle. Admixture of organic substances with sand is helpful in the propagation of cuttings of a number of ornamental plants which ordinarily root only with difficulty.

7. The acidity of the sand is the most important consideration. A pH of 6 or less is preferable.

8. Some varieties of cuttings root best when the reaction of the medium conforms to that in which the parent plants are known to produce maximum growth.

9. The efficiency of a mixture of peat moss and sand appears to be mainly due to its relatively high moisture-retaining capacity and in some cases to its acid reaction.

10. Another type of medium which has given good results with different cuttings, especially of acid-loving plants, is peat moss. Its very high waterholding capacity, however, renders the cuttings liable to rot before they commence to root.

11. Under conditions of high moisture and temperature those containing charcoal were generally best, as in the rooting of avocado and mango cuttings.

12. A clay medium favoured callussing in contradistinction to sand which favoured rooting.

(b) *Depth of planting:* 1. Deep planting prevents desiccation but reduces aeration.

2. Deep planting assures firmness to cuttings which is conducive to rooting, but it should go no deeper than it suffices to maintain it steadily in the soil. A dibble should not be used because of the danger of an air pocket between the base of the cutting and the rooting medium.

3. Though cuttings normally root at the basal end showing strong polarity, they also tend to root more at the surface of the medium due to better aeration.

4. Very deep planting renders the lifting of rooted cuttings difficult, especially in compact soils.

(c) *Position of basal cut;* 1. Although most plants propagated by cuttings will root at the node, a cut at some other portions, above the node or below it will give even better results.

2. Whether or not a cutting will produce roots largely depends on the root initials.

3. Roots are of two kinds; wound roots and morphological roots. The former usually appear directly above the callus and are not in any definite relation to the anatomical structure of the plant tissue. The morphological roots on the other hand, have a definite relationship to the anatomical structure of the tissue but may vary with different species of plants. The so-called morophological roots arise in many cases from the root initials located in the meristematic tissue which is present in the internodal region as well as at the node of the cutting. Therefore both the types or roots are important. As the wound roots are produced directly above the callus, it does not matter whether the cut is made at the node or elsewhere.

4. A large percentage of root initials is located in the first half-inch below the node.

5. Out of 86 plants studied, Laurie and Chadwick (1931) five rooted best when cut at the node, 41 when the cut was made a short distance below the node and 23 gave equally good results in at least two of the three regions of cutting.

Material and Methods:

Rooting media: The following six media were tried. (1) *Tank Silt:* Made up of fine particles but not sticky. (2) *Orchard Mixture:* A mixture containing three parts tank silt, three parts river sand, two parts red earth and two parts leaf mould. (3) *Orchard Mixture and sand:* (1 : 1). (4) *Sand:* River sand - fine to coarse. (5) *Red-earth:* Consisting of a large proportion of sand. (6) *Clay:* Slightly sticky clay from tank beds. Raised beds of the above materials $3' \times 2' \times \frac{3}{4}'$ were prepared.

Cuttings of *Panax Sp.* were selected for the purpose, due to the uniformity and the availability in required numbers during the period of the trials. About a year-old cuttings, six to seven inches long and roughly of the thickness of a pencil were selected for the purpose. Thirty cutting per treatment were planted in rows of 10 each, in each bed.

PLATE I — Rooting media : Sand, red earth and clay.

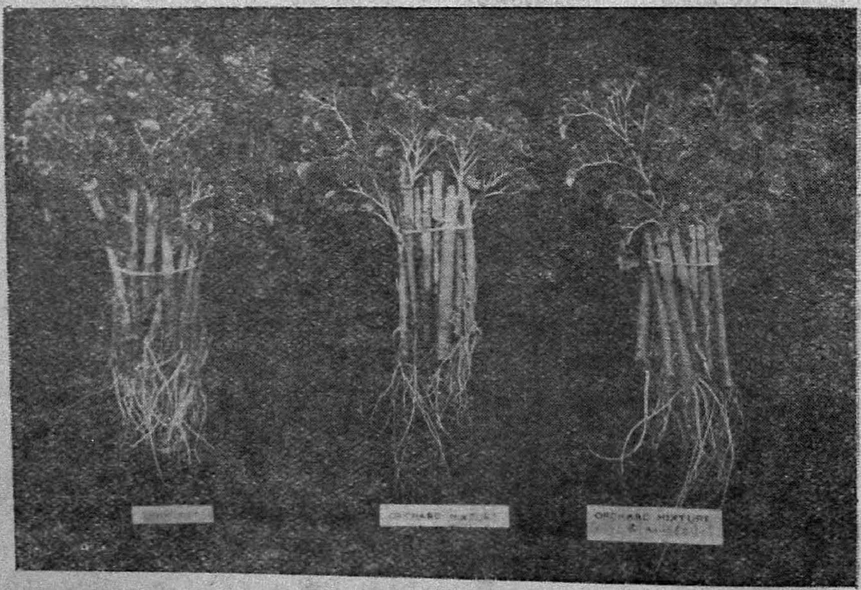

PLATE II — Rooting media : Tank Silt, Orchard Mixture and Orchard Mixture : Sand (1 : 1)

Results : The results are presented in the following table and a general view of the rooting as observed in the several treatments is shown in plates I and II.

It can be seen from the plates that although the difference between the treatments is not very striking the cuttings planted in tank silt and sand, were found to lead others in root production, closely followed by those in red-earth, clay, orchard mixture, sand, in the order presented here. Thirty cuttings were planted in each treatment.

Particulars	Tank silt	Orch Mix.	Orch. Mix. & sand	Sand	Red earth	Clay
Number rooted	26	18	21	26	20	16
Number of roots	364	135	179	274	228	154
Weight of roots (in gms.) ...	145 6	35·8	58·8	119 0	86·5	43·3
Mean No. of roots per cutting ...	12·1	4·5	5·9	9 1	7 6	5 1
Mean Weight of roots (in gms.) ...	4·8	1·1	1·1	3·9	2 8	1 4

It may be concluded that : (1) The number of cuttings that rooted is the largest in sand and tank silt media, while orchard mixture and clay did not appear to be very favourable. (2) Correspondingly large number and weight of roots were formed in tank silt and sand media. (3) While tank silt leads sand in the number of roots, the difference when viewed in terms of weight is considerably narrowed down. (4) Among the four treatments, orchard mixture, sand and red-earth seem to be better than clay and orchard mixture alone, in respect of the total number of cuttings that rooted in each of these media. (5) Taking the weight of the roots into consideration it is seen that 'tank silt' again leads the other treatments.

It can be said from these data that clay as obtained in this instance is definitely unsuitable as a medium for rooting, although the same amount of definiteness cannot be asserted in the case of orchard mixture.

Depth of Planting : Stem cuttings of grapevine (*Vitis vinifera*), '*Pachadrakshai*' variety, about the thickness of a pencil and with three to five nodes in each were selected. Care was taken to see that the material was as uniform as possible.

Treatments : The following three treatments were tried ; 1. Planting with one node under the soil. 2. Planting with two nodes under the soil. 3. Planting with three nodes under the soil.

Ten cuttings were used for each treatment. The rooting medium was a raised bed (about 3′×2′×¾′) of fine to coarse river sand without the addition of any other material.

Results : On the 73rd day after planting, all the cuttings were removed by careful and gradual washing away of the sand without damaging the fibrous roots.

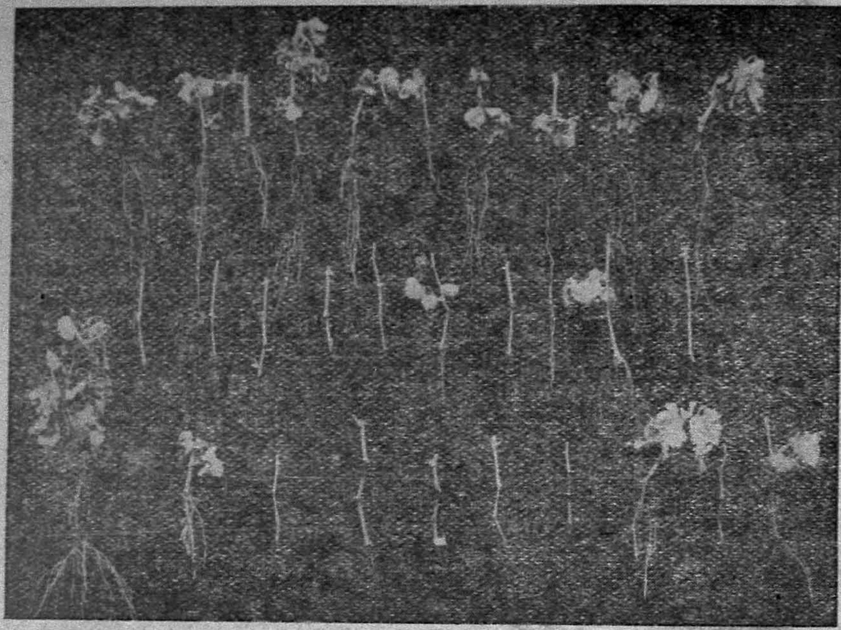

PLATE III — Depth of planting: One node (1st row); two nodes (2nd row) and three nodes.

The rooting response under each treatment is represented in Plate III in the order one node, two nodes and three nodes.

An attempt was also made to record the number of roots obtained from each cutting and their total dry weight. The actual number of roots, irrespective of the size was counted and as the variation in size and length of roots was found to be enormous, the comparison by weight was adopted. The details are furnished in the following table :

Treatments—Depth of Planting.

Cutting No.	One Node	Two Nodes	Three Nodes
	Number of Roots		
1.	4	1	12
2.	21	...	16
3.	13	1	29
4.	8	...	15
5.	14	18	2
6.	6	9	3
7.	14	...	...
8.	2	1	1
9.	5	...	2
10.	8	1	...
Total ...	95	31	80
Mean No. of Roots per Cutting ...	9·5	3·1	8·0
Total Weight (in gms.) ...	3·62	0·32	1·85

As the roots were too brittle and in some of the cuttings too scanty, it was found desirable to take the total weight of the roots of all ten cuttings together.

The cuttings planted with one node under the soil were remarkably uniform with profuse root formation. Of those with two nodes under the soil, only six cuttings showed slight rooting, of which the rooting in four could be deemed as almost negligible. The cuttings with three nodes under the soil, however, occupied an intermediary position, with eight rooted, of which four had produced a fairly large number of roots.

A study of the table reveals that the 'two node' treatment can be ruled out as the least promising. Between the other two treatments, the difference is only 15, the corresponding figures for 'one node' and 'three nodes' being 95 and 80 respectively. Expressed in percentage, the 'one node' treatment has produced 18.8% more roots than the 'three nodes' treatment. It is, however, interesting to note that when the weight is considered the position is considerably altered. Although there is no change in the order of superiority of the treatments, the roots obtained from the 'one node' treatment weigh 95·4% more than those of the other. This is due to the varying lengths of roots ranging from mere stubs to those measuring even as much as five to six centimetres and to the varying thickness of the roots.

Observations at the seat of emergence of roots showed that in seven out of ten cuttings planted with one node under the soil, the roots were concentrated about ½ to ¼ inch above the terminal end while in the remaining three cuttings some roots were also formed higher up, almost just beneath the soil surface. In the 'three nodes' treatment, although a major portion of the roots was formed at the terminal end, fairly large clusters also emerged from the two nodes higher up.

Basal Cut: Stem cuttings from one-year old wood of the following plants were selected.

1. *Panax Sp.*
2. *Eranthemum Sp.*
3. *Bougainvillea Sp.*
4. Mulberry. (*Morus alba.*)
5. *Moringa pterigosperma.*
6. *Glyricidia maculata.*
7. Acid lime (*Citrus aurantifolia*)
8. Lemon (*Citrus limon.*)
9. Pomegranate (*Punica granatum.*)
10. Jasmine (*Jasminum flexile.*)

Treatments: The following were tried: 1. Cut at the node. 2. Cut ½″ above the node. 3. Cut ½″ below the node. Ten cuttings were taken for each treatment. In some cases as in *Panax* the internodes are so short that a cut made ½″ above a particular node was not different from a cut ½″ below the node. In such cases only two treatments were considered. The cuttings were removed for examination 116 days after planting. Of the ten tried, only four batches survived. These were *Panax*, *Bougainvillea*, *Eranthemum*, and mulberry. Except in the case of *Bougainvillea* it was seen that the cut 'at the node' seems to have favoured better rooting than the other treatments.

In respect of these four materials the cut at the node seems more desirable. It is also noticed that of the other two treatments the cut ½" below the node seems to have been better in three types out of four.

Discussion: Most workers have favoured sand as the medium for satisfactory rooting but a mixture of peat and sand has been found to be better than peat and sand alone. This is seen in the present trials where the cuttings in orchard mixture: sand (1 : 1) proved to be better than in orchard mixture alone. The promising performance in tank silt and red earth is analogous to the findings of Woycicki and Terpenski (1937) quoted by Garner (1944) that the moisture of a sandy medium has a marked effect on rooting. Sand with 25% water-holding capacity was unsuitable, while they considered a capacity of 50 to 70% to be the best. The red earth and tank silt used here being more or less sandy in nature have both the required water-retaining capacity and adequate aeration.

Although clay as a medium has not been very encouraging, yet it seems worthwhile noting the observations of Knight (1926) who found that clay favours callussing while sand favours rooting. This special feature of clay seems especially desirable in the case of cuttings which are moderately difficult to root in a normal sandy medium. Planting such cuttings in the clay medium to begin with and transplanting in a sandy medium after the formation of callus is a method which may yield useful results.

Somewhat contrary to the findings reported by workers elsewhere is the poor rooting observed in the cuttings in orchard mixture medium, which was made of leaf mould, sand, farmyard manure and red earth. At least in respect of cuttings of *Panax* the addition of such moisture-retaining ingredients as farm yard manure and leaf mould, seems to be not only superfluous but also unfavourable for satisfactory root formation.

The influence of depth of planting cannot be separately assessed from that of length of cutting, for one bears a proportionate relation to the other. The condition at the base of the cutting is chiefly governed by the depth of planting. The profuse and uniform rooting obtained with the cuttings planted with one node under the soil is a feature which is striking and this is all the more interesting when the almost negligible rooting in the 'two node' treatment is considered. The difference is too large to be ignored. The only possible reason that can be advanced for this specially noteworthy feature in the 'one node' batch of cuttings is the greater aeration afforded by the shallow planting and concentration of the root-forming substances within one node. In the other two treatments the deeper planting appears to have not only inhibited proper aeration but might have also distributed the root-forming substances over a wider area and in the absence of necessary stimuli such as aeration, moisture etc., the activity of these substances should have been restricted to some extent in a few cuttings and reduced to negligible proportions in some others.

The observations in regard to the position of basal cut are in agreement with those of Laurie and Chadwick (1931) who have stated that the cut should be made through the node for the best rooting, the reason advocated being that greater amounts of nutrients are stored at the node and as a consequence quicker regeneration of the tissues takes place and the adventitions buds are forced out rapidly. While some workers advocate cutting at the node or below it, much is not said in favour of the cut above the node and the present trials also indicate that the cut above the node has not responded well enough to recommend its adoption.

From the point of view of the nurseryman it can be said with some measure of certainty that these findings will not only minimise his losses in the nursery but will also help him multiply his stock by adopting judicious methods of planting. As a rule the nurseryman is not aware of the finer distinctions in terms of optimum depth of planting or position or nature of basal cut, which the cuttings demand for the best success. He consequently assumes the failures he faces as inevitable and consoles himself by attributing them to wrong selection of planting material. If therefore, the implications of the results of a trial of the type described here are appreciated and adopted by him in dealing with his material, it is needless to mention that he will certainly stand to gain by minimising avoidable losses. It cannot also be held that a recommendation suggesting for instance, the planting of grapevine cuttings with only one node embedded in the soil requires any extra effort or attention nor can such an improvement in the existing methods be deemed as uneconomical.

These observations, though limited to only cuttings of certain kinds, nevertheless, are such that may be expected to apply to other types also. On this score, the need for conduct of similar trials, with these plants dealt with by nurseries on a commercial scale, is manifest.

SUMMARY.

1. The findings of several workers on the choice of rooting media, depth of planting and the position of basal cut have been reviewed.

2. Among the various media tested by the author, sand and tank silt appear to be very favourable, while clay was unsuitable.

3. Planting cuttings of grapevine with one node under soil proved to be best in the matter of root-production.

4. Planting with two nodes under the soil was definitely unsuitable, while cuttings with three nodes embedded in the soil occupied an intermediary position.

5. A cut at the node favoured better rooting in respect of cuttings of *Panax*, *Eranthemum*, and mulberry.

6. Between the other two treatments viz: cut ½" above and cut ½" below the node, the latter was found to be better in three types out of four.

Acknowledgments. The author is grateful to Sri S. N. Chandrasekhara Iyer, M. A., Government Lecturing and Systematic Botanist, Coimbatore, under whose guidance the work was carried out and to Sri U. Narasinga Rao, B. Sc., (Ag.), Fruit Specialist, Madras, for his valuable guidance in the preparation of this paper.

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A note on the Interspecific Hybridisation in Sesamum

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In the course of the cytogenetical studies of the genus *Sesamum* (Gingelly), most of the available wild relatives of the cultivated species viz.—*Sesamum prostratum* Retz, *Sesamum laciniatum* Klein, *Sesamum radiatum* Schum, *and Sesamum occidentale* Heer & Regel., were found possess to very valuable characters like disease and drought resistance. Most of the cultivated varieties of *Sesamum indicum* Linn. (Syn : *Sesamum orientale* Linn.) are found to be susceptible to the attack of *Antigastra catalaunalis* in the early stages and to the virus disease "Phyllody". With a view to get an economic type with all the desirable qualities, the species were crossed inter-se and some interesting results have been noted regarding the crossability of the species. The results of the crossability between species obtained from the present and earlier studies are presented in the table below :—

♀	Sesamum indicum n=13.	S. prostratum n=16.	S. laciniatum n=16.	S. radiatum n=32.	S. occidentale n=32.
Sesamum indicum n=13.	Self.	XX	XX	*	*
Sesamum prostratum n=16.	XX	Self.	XX	*	*
Sesamum laciniatum n=16.	XX	XX	Self.	*	*
Sesamum radiatum n=32.	**	**	**	Self.	XX
Sesamum occidentale n=32.	**	**	**	XX	Self.

XX — Set fruit and good viable seeds are obtained.

** — Set fruit, both shrivelled and normally developed seeds are obtained.

* — Failed to set fruit.

Out of the twenty crosses only fourteen crosses were done here and the four crosses were previously done at the Division of Botany, Indian Agricultural Research Institute, New Delhi. From the crosses effected here, the results are summarized as follows :—

1

2-a 2-b

3

1. In the crosses *S. prostratum* x *S. laciniatum* and *S. occidentale* x *S. radiatum* and its reciprocal where the chromosome numbers of the parents (n x n = 16 x 16 or 32 x 32) did not differ, high crossability was noticed and the hybrids were fertile.

2. In the crosses *S. indicum* x *S. laciniatum* and *S. indicum* x *S. prostratum* where the chromosome number differs by three (n x n = 13 x 16) a partial setting was obtained and the F_1 plants proved to be practically sterile.

3. In the crosses *S. occidentale* x *S. indicum*., and *S. occidentale* x *S. laciniatum* where the chromosome number of the parents (2n x n = 32 x 13 or 32 x 16) differ widely, setting was observed giving rise to both shrivelled and normally developed seeds which failed in germination.

4. Complete failure resulting in the dropping off of the entire crossed flowers was noticed in crosses *S. indicum* x *S. occidentale*., *S. laciniatum* x *S. occidentale* and *S. laciniatum* x *S. radiatum*., where the lower chromosome number (n x 2 n = 13 x 32 or 16 x 32) plant was used as female.

Ramanujam (1942, 1944) has synthesized *Sesamum indicatum* (2n = 58) an amphidiploid of the hybrid *Sesamum orientale* x *Sesamum prostratum* (2n = 13 + 16) by doubling of the chromosomes of the hybrid. This was found to be fertile with certain desirable qualities like disease resistance, but was found to be low in oil content and not suitable for cultivation. They were backcrossed with *S. orientale* and further work is in progress at I. A. R. I., New Delhi.

Working on similar lines, the hybrid of *S. indicum* x *S. laciniatum* (2n = 13 + 16) obtained at Coimbatore was found to be intermediate in respect of several characters (Fig. 2a) of the parents (Figs 1 & 3) but showed dominance towards pest and disease resistance. The hybrid in spite of profuse flowering proved to be completely sterile and set no fruit. The study of meiosis in pollen mother cells showed 29 chromosomes that is (2n = 13 + 16) the number equal to the sum of the genomes of the parents. At Metaphase I, the chromosomes formed varying numbers of bivalents and univalents and occasionally a trivalent also was noticed. The maximum number of bivalents noticed in any one cell was nine. In most of the cells, the chromosomes were found scattered in the spindle. The Anaphase distribution was found to be irregular, which resulted in the abortion of most of the gametes. Back crossing with the parent proved to be a failure and flowers were shed on the third or fourth day.

In order to get a fertile amphidiploid progeny the vegetative buds of the sterile hybrid were treated with 0·4% aqueous colchicine on three consecutive days in the early mornings. A few shoots from the treated buds were seen showing the symptoms of colchicine effect (Fig 2a).

But only one branch proved to be affected and the pollen grains of this showed a marked change. Most of them were bigger in size and full of contents. These flowers with good pollen are developing capsules. The progeny of the newly produced double diploid or amphidiploid is expected to provide material for further study and the work is in progress at the Cytogenetics section, Agricultural College and Research Institute, Coimbatore.

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EXPLANATION OF PLATES.

Fig. 1— *Sesamum indicum* Linn. TMV 1. Female parent. 2=26.
Fig. 2a– F_1 hybrid of *S. indicum* x *S. laciniatum*. 2n =13 x 16.
Fig. 2b– Colchicine treated plant.
Fig. 3— *Sesamum laciniatum* (wild species) male parent. 2n=32.

Herbicides and their Scope in South India *

By

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Introduction: Weeds are undesirable plants. Muenscher (35) has defined weeds as plants which grow where they are not wanted or where it is desired that something else should grow. In short, they are plants out of place. Weeds compete with crops for light, moisture, plant food and space. They seed profusely and thrive even under adverse conditions, unlike crop plants. The seriousness of weed competition has been recognised ever since man began the cultivation of crops; but despite rapid advancement of science, weed control still remains a problem.

The annual loss due to weeds alone in the United States of America is estimated to be over 300 million dollors, greater than the losses sustained by the farmer due to livestock diseases, insect pests and plant diseases.

* This paper was awarded the Ramasastrulu Munagala Prize in July 1950.

Methods of control: Measures to control weeds are chiefly; prevention, eradication and extermination. The preventive measures aim at the use of clean seeds of crops and preventing seed production of weeds. The methods eradication can be classified into three groups, viz; mechanical, cultural and chemical.

Mechanical means of eradication lie in the use of machines and implements. These are in vogue in several countries in the West. The cultural methods of control are based on the rotation of crops, mixed cropping, use of smother crops and interculture with suitable implements. Interculture is the most economical device aiming at moisture conservation along with weed control. Its main drawback lies in its failure to control deep-rooted weeds. Yet it remains as one of the most successful and practicable methods of weed control. Weed control through biological agencies is risky as the crop is rarely immune when the less susceptible weeds get the infection. One example of success achieved in this field relates to the control of prickly pear (*Opuntia sp.*) by the coccid insect introduced from abroad. Owing to the limited scope of weed control by this method, early investigators concentrated on chemical means for successful weed control.

Chemical means of weed control: The birth of this century saw the utilisation of chemicals as a means of weed control. These are known as herbicides or weedicides or popularly as weedkillers. These are largely in use in foreign countries and can be grouped into soil sterilisers, translocated and contact poisons, according to their mode of action.

The possibility of destroying weeds by herbicides was discovered in France a few decades back. The earliest substances to be used were copper sulphate and sodium chlorate. Arsenical organic compounds came into usage later. These are poisonous, toxic to soil, plants and animals. Owing to these drawbacks their use was discouraged. Ammonium thiocyanate, which did not have these drawbacks drew attention for sometime; but its prohibitive cost limited its use Sulphuric acid and copper sulphate gained currency as contact poisons. There are low-priced and easily available, but are corrosive and are unable to exterminate deep-rooted weeds.

Contact poisons: In 1932, a dyestuff known as dinitro-ortho-cresol was found to have the property of killing herbaceous plants. This was relatively harmless to animals and inexpensive. It gained foothold in several countries and became very popular. Several products in the form of powders, pastes or emulsions entered the market and these are in use even to day. Sandoz, Dinoc, Dinocate, Sinox etc., are some of the commercial names of weed killers of this class containing dinitro-ortho-cresol as their main ingredient. These substances have proved to be only contact poisons as they are not absorbed and translocated in plants. These are specially in use against succulent and herbaceous weeds growing among cereal crops. Most of the annual weeds are controlled by spraying five to ten pounds of the substance in 100 gallons of water over an acre.

Translocated poisons: The idea of using synthetic growth-regulating substances as weedicides originated simultaneously in U.S.A. and in the United Kingdom during the last war. Several growth-regulating substances largely used in horticulture for inducing rooting, improving fruit-set, controlling fruit drop etc., when used in high concentrations were found to induce overgrowths and malformations in plants resulting ultimately in their death. Wyndham Murray (57) states that this toxic property with selective action in these substances was discovered in 1940 by a team of British scientists headed by Blackman. Later, several investigators showed that these substances could be used effectively for destroying weeds among crop plants. Soon after the war, several articles appeared in many scientific journals on the utility of growth-regulating substances as weedkillers. The commercial preparations largely advertised and recommended for use are Sinox, Weedone, Weed No More, Weedanal, Weedust, Barweed, Tufor, Fernoxone, Agroxone, Methoxone etc. Most of these substances are derivatives of phenoxy-acetic acids. Of these, 2·4-dichloro-phenoxy-acetic acid, popularly known as 2·4-D, is the most effective substance discovered so far. Kaphart (24) used the term 'revolutionary discovery' for this substance because it opened up a new approach to weed control, by growth regulation through translocation in the plant system.

These herbicides are stated to be superior to the old type of chemicals in that they are inexpensive, selective in their action, harmless, to man and soil, non-poisonous to animals, non-corrosive and non-inflammable. As a result of these features, growth-regulating substances have become widely publicised, and exploited as proprietary products of commercial firms. Many firms in South India are now importing 2·4-D or closely related dervatives for sale to agriculturists.

Mode of action of growth-regulating herbicides: Commercial weedkillers containing as their main principle, derivatives of phenoxy acetic acids are readily absorbed by the plant and are transmitted from foliage to root. Their movement occurs mainly through the xylem and is limited by the factors which influence transpiration. The changes induced by them occur in places far removed from the place of application. Even underground parts are stated to succumb to these substances. These derange growth metabolism, increase respiratory activity leading to depletion of carbohydrates. The visible changes are, distortions of growth, malformations, bending of stems, twisting of leaves and inhibition of growth at the meristem. The effects are characteristic of all phenoxy-acid derivatives. Beal (6) calls them as 'telemorphic' effects. Hamner and his associates (16) have shown that the esters are more effective than acids and acids more effective than salts. Several investigators, Marth and Davis (34), Hamner and Turkey (15), Mitchel and Marth (29), Beal (9), Weaver and Rose (53) and Weaver and his associates (54) have proved that sunshine, dry weather, high temperature etc. accelerate their efficacy and organic matter, rain, moisture etc. retard or mitigate the adverse effect of herbicides. Young plants as a rule are more susceptible than older ones.

These substances are relatively non-toxic to animals. Bucher (10) has shown that only 280 mgms. per kilogram of body weight was lethal to mice. These are selective in action, destroying some plants while not killing others and also have a persistent effect. In the beginning, these selective herbicides were stated to be effective in killing mostly dicotyledonous plants and popular literature went to the extent of saying that their efficacy was limited to dicotyledonous plants only. This led to the misconception that all nonocotyledonous plants were resistant. At present all broad-leaved plants are stated to be more effectively controlled by phenoxy-acetic acid derivatives than narrow-leaved plants.

Work in India: The virtues of these herbicides, their increasing use in temperate countries as well as their wide publicity, has induced the committee of the Indian Council of Agricultural Research on Soils and Crops held in Patiala in March 1950, to draw up a scheme of large-scale trials in different parts of India.

Very little systematic survey has been made in South India of crop plants and weeds susceptible or resistant to herbicides. A beginning has recently been made. Padwick (37) was the first to use growth regulators as herbicides under our conditions. Later Thomas and Srinivasan (48) and Kumar and his associates (28) have published some lists of susceptible weeds under our conditions. So far no popular bulletin on herbicides has been published in India similar to the ones released by the U. S. Department Extension Service bulletins.

The control of weeds using herbicides is a new venture in South India and is full of risks. As these herbicides are lethal to non-cereal crops, indiscriminate use may result in a total loss of crop. Before launching any such large-scale trials in India, an attempt has been made here to review the existing voluminous literature on herbicides, useful to our conditions, and conduct preliminary trials at the Agricultural College, Bapatla, to assess their influence on crops, weeds etc. and the limit of safety of these compounds under South Indian conditions, with a view to evaluate their future possibilities.

Review of Literature: A review of the work on hormone weed-killers upto 1947 since their discovery has been published by Avery and his associates (5), Mitchell and Marth (33) and by Overbeek (49) and in several publications by Zimmermann and Hitchcock in the contributions of the Boyce Thompson Institute of Plant Research, New York. Since then, the use of synthetic hormones as herbicides has developed very rapidly. The present review deals with the use of growth-regulating substances for herbicidal purposes upto 1949.

The most comprehensive account of weed control is contained in the Report of Research Committee of the North Central Weed Control Conference published in December 1947, based on over 200 experiments carried out by several investigators. The present recommendations spring from these experiments.

Weed surveys: Several investigators have listed susceptible and resistant species of weeds under temperate conditions in U. S. A. In India such work has just now commenced. Various commercial firms have carried out trials with their own scientists and have advertised the susceptible weeds with instructions regarding the dosage of the substances for weed eradication. Van Overbeek (49) has indicated the herbicides likely to be useful under tropical conditions, but no survey has been made by him.

Sensitive weeds and crop plants: Dense bushy weeds, even woody plants, clogged acquatic weeds in pond and pools are reported to be exterminated by the use of hormone weedkillers. Hamner and Tukey (15) report of *Convolulus arvensis* (Bind weed) being killed upto a depth of 14 inches by a single spraying of 2·4-D at 1000 p. p. m. Mitchell and Marth (29) class *Plantago lanceolata*, *Stellaria media* (chickweed), *Hydrocotyl* sp (pennywort) *Prunella vulgaria* etc. as highly susceptible weeds in lawns. Hildebrand (20), King (26) and Thomas and Srinivasan (48) claim water hyacinth, *Eicchornia crassipes*, as one weed successfully exterminated by selective herbicides. Poison ivy, dandelion wild garlic, alligator weed, charlock, thistles, ragweed etc. are some of the other common weeds reported by Avery and his associates (4) as capable of eradication with 2·4-D. Even at 2 p. p. m. this is stated by Jorgensen and his colleagues (22) to kill 95 to 98 per cent of seeds of common weeds.

The legumes are highly susceptible to herbicides. Wood (55) has shown that their use is full of risks even when legumes are found as mixtures. Brassica and lettuce are equally sensitive. Krauss and Mitchell (27) found buckwheat, radish, beans etc, succumbing within ten days when 2·4-D was applied and even very low concentrations are reported to be toxic to vegetables. As most of the vegetable crops are sensitive to herbicides, they are ruled out for herbicidal treatment. Tam (44) reports that weed control with hormone weedicides has no place under Hawaiian conditions, owing to the susceptibility of pineapples.

Partly Susceptible Plants: *Cyperus rotundus* (Nut grass) is classed by several workers as a weed susceptible to hormone weedkillers. Hildebrand (21) has indicated that in Florida and Texas 0·1 per cent of 2·4-D was effective in killing the above ground parts of this weed. Agricultural Journal, Fiji has reported that nut grass can be eradicated by using herbicides. Van Overbeek (50) and his associates found that a single application of 0·3 per cent of 2 4-D was effective in controlling nut-grass, *Commelina* and other weeds in sugarcane fields of Puerto Rico. Plant Protection Overseas Bulletin (39) also records that in the West Indies, successful control of nut grass was obtained using 10 per cent agroxone. Two to three sprayings are advocated for long established weeds. The Imperial Chemical Industries bulletins also claim eradication of nut grass with Agroxone and Fernoxone. Kumar and his associates (20) are of the view that 0·2 per cent Agroxone can eradicate nut grass. Arthur James (3) has supported these observations from anatomical studies. Only Crafts and Emanuelli (10) report that nut grass, *Commelina* sp. *Ipomoea* sp. survived and soon resumed growth, after 2·4-D was sprayed.

Herbicides for Crop Plants: Avery (4), Mitchell and Marth (29 and 31) report of selective herbicidal properties of 2·4-D leading to its exploitation for weed control in lawns. The use of hormones for herbicidal purposes, as sprays, dusts, mixtures and emulsions with fertilisers has now become a standard practice in lawn and turf culture.

The recommendations for treatment of grain and other cereal crops against weeds depend upon several factors which influence the effectiveness of herbicides. Irrespective of these factors the mode of application is important for safe treatment of crops. The methods of treatment fall under two groups: pre-emergence treatment, applying the herbicides are applied to the soil before the emergence of the crop and post-emergence treatment, applying the herbicides after the crop has made some growth. Rayner and Otis (41) have stated that in California aeroplane sprayings at the rate of 1·25 pounds per acre controlled several weeds without causing injury to crops. Yet post emergence applications are found to cause adverse effects and therefore 0·5 pounds per acre is considered the maximum safe dosage for this mode of treatment.

Wyndham Murray (57) states that linseed production could be doubled by using 2 kilograms of 2·4-D when the crop was 3 to 4 inches high. Anderson and Wolfe (2) could effectively control weeds in maize without producing any injurious effects on the crop. Dusting is reported by Ryker (42) to be as efficacious as spraying in controlling weeds in rice. Patty Shannon (38) found similar efficacy in weed control in rice, sugarcane, flax, corn and grass. For the northern States of Canada, 0·25 lb. of 2·4-D is considered the maximum dosage against broad-leaved annual weeds at the tillering stage, or the rosette stage for flax, and up to 0·75 lb. for perennial weeds before the flax blooms. Brown and Ryker (7) and Hildebrand (21) report effective weed control in sugarcane with 0·2 per cent 2·4-D at 100 gallons per acre in water. Reviewing the entire work on post emergence treatments of herbicides, Zimmermann and Hitchcock (60) view that from the standpoint of economic importance, weed control so far has been limited to small grains, corn, and flax; the latter heading the list of crops. But most of the post-emergent treatments have failed to control grasses in contrast to pre-emergence treatments. Despite this, Willard (56) found that broad leaved perennials immune to all the above modes of treatments.

Vegetables as a class are sensitive and do not lend to any other type of treatment. The legumes are equally sensitive and post-emergence treatments have been ruled out. In tests by Grisby (14) with 25 different vegetables, pre-emergence treatments with 0·32 lb. of butyl ester of 2·4-D, weeds were checked for six weeks without any injury to the crop. Pre-emergence treatment is the only method thus far developed to control broad-leaved annuals and grasses. Many grasses as well as, Derris, Erythrina, Lantana etc., are reported by Van Overbeek (50) and Tam (44) to resist herbicides. Several activators and mixtures of herbicides are increasingly coming into use to control these weeds by accelerated translocation. Templeman and Sexton (47), Taylor (45) and Allard and others (1) found another substance isopropyl carbamate, popularly known as IPPC, to be of more value in place of 2·4-D for destroying grasses. Unlike 2·4.D several broad-leaved plants are stated to be resistant to this substance.

Residual Effects on Soil: The toxic effect of herbicides on soil has not been overlooked and several attempts have been made to assess this toxicity. Most of the studies are based on seedling emergence tests. By far the simplest and rapid method of detecting small amounts of herbicides as evolved by Daniel and Virginia Grant (13) is based on its inhibiting effect on the growth of cucumber seedlings even at 0·005 p. p. m. Mitchell and and Marth (30), Taylor (46) and others observe that phenoxy-acetic acid derivatives generally remain in the soil and suppress growth or early germination of susceptible plant and to a lesser extent cereals and grasses. In alkaline soils, the toxic effects are found by Hanks (19) to persist longer.

Mitchell and Marth (30) found that the soil was strongly toxic even after 18 months storage of air-dry soil low in organic matter. In fact, in arid parts of California 2·4-D is reported by Avery and his associates (4) to stay for six months or longer. Taylor (46) reports that 2·4-D treatment persisted in the soil and suppressed plant growth for about four months. With maize, the residual effect was found to last for seven weeks when 4 pounds of 2·4-D was used per acre (46). Oliver Kries (36) noted that for mustard and marigold the toxic effect lasted for four weeks.

The rate of inactivation of 2·4-D was found by Brown and Mitchell (9) to depend on the moisture content of soil, temperature and manuring. Weaver (52) reports that though the treated soils were toxic even 45 days after the application of herbicides, ploughing considerably decreased toxicity even when 10–15 lbs. of herbicides were applied to an acre and only the upper three inch layer was found to be toxic even after rains. In this repect, the esters are found by Staten Glen (43) to be toxic as they volatilise in hot dry climates and injure crops.

Mitchell and Marth (33) have found that organic matter and cropping mitigate the toxic effect of herbicides. DeRose (12) finds that 2·4·5 tricholorophenoxy-acetic-acid persists for a longer time than 2·4-D. Crafts (11) has therefore sounded a note of warning to all those contemplate using herbicides for weed control.

Crop plants in South India susceptible to herbicides: Three proprietary preparations of herbicides, Agroxone, containing 10 per cent sodium 4 chloro-2 methyl-phenoxy-acetate, Fernoxone containing 80 per cent of salt of 2·4-D, supplied by the Imperial Chemical Industries Ltd. and Sandoz A. a dinitro-orthocresol preparation supplied by Shaw Wallace & Co., and the hormone 2·4-D in pure acid form, were used on crop plants at 0·1 per cent solution in water.

25 different species of common South Indian vegetables used for the trial were found to succumb to all the herbicides even at this strength. It can be stated that as a class South Indian vegetables are highly susceptible to herbicides in the strength they are used for controlling weeds and hence post-emergence treatments are to be avoided.

Similarly crop plants showed different degrees of injury and cereals were relatively less sensitive. Even at mature stages, when the herbicides were used as spray on grain crops like paddy *(Oryza sativa)*, Ragi *(Eleusine coracana)*, Sorghum *(Sorghum durra)*, Cumbu *(Pennisetum typhoides)* etc, the crops showed symptoms of injury and there was no absolute resistance. The highest degree of resistance was shown by the minor millets, Samai *(Panicum miliare)* Kudirivali, *(Echinochloa frumentacea)*, Panivaragu *(Panicum miliaceum)*, and varagu *(Paspalum scrobiculatum)* as well as by sugarcane at mature stages.

Most of the grasses were found highly resistant to the derivatives of of phenoxy-acetic acids, barring a few namely, (*Eragrostis wildenoviana, Chloris barbata, Cenchrus ciliaris etc*), that were found to be susceptible.

Several investigators have claimed that nut grass (*Cyperus rotundus*) is killed by herbicides and commercial firms have also advertised in their catalogues to this effect. Detailed investigations conducted at the Agricultural College, Bapatla, showed that the underground parts are highly resistant and the herbicides are not translocated to these portions. The underground stem is really a corm with several buds located below the central bulb-like stem. The leaves translocate the hormones to the central meristem and the tissue at the core succumbs. The hormone is not transmitted farther to other dormant buds below as well as to those underground corms connected through the stolons. This feature is responsible for the survival reported by Crafts and Emanuelli (10), Tam (44) etc. Repeated sprayings help to destroy subsequent growth, but this is not practicable and economical and the residual effects are bound to persist for longer periods. This weed is therefore to be classed as a partly susceptible one.

Residual effects on South Indian soils: Weaver (52) has indicated that growth-regulating substances even if applied at very high doses remain mainly in the upper three-inch layer of soil. To assess the toxic effect of these herbicides on soil, weighed quantities of clay and sand were filled in cement tubs of 18 inch size and herbicides were applied at 5 and 10 P. P. M. by weight of soil and several crops were sown or transplanted 15 and 30 days after such applications.

These simple experiments, indicated that sensitive plants belonging to Cruciferae, Solanceae and Leguminoseae grew normally when they were sown or transplanted one month after application of herbicides provided the soil was left exposed and frequently watered. Sowings made a fortnight after the application of herbicides failed to germinate, indicating the persistence of toxic effects of the herbicides. Only the cereals, Sorghum,(*Sorghum durra*) Wheat—(*Triticum sativum*), and maize, (*Zea mays*) germinated and grew subsequently. In tubs which were not watered at any time before sowing, even after 30 days toxic symptoms were perceptible when only 5 p. p. m. of of herbicide by weight of soil were used. The trials showed that rainfall or irrigation help to mitigate toxicity by leaching. In sandy soils, the toxicity disappeared quickly within a month after application of herbicides, equivalent to 10 pounds per acre at a dilution of 10 p. p. m.

Discussion: The use of growth-regulating substances for herbicidal purposes was one of the technical secrets of war to be released recently. These were ushered with great enthusiasm and almost every scientific journal and popular magazine was filled with exaggerated headlines about the herbicidal properties of growth-regulating substances and potentialities. These have now gained great importance as means of weed control in lawns, turfs and in a few cereal crops. These are also claimed as promising temporary soil sterilants for killing seeds of weeds. Though these are claimed to be effective, persistent poisons for controlling deep rooted perennials, they have failed to control (*Saccharum spontaneum,*) Hariali, (*Cynodon dactylon*) or nut grass, (*Cyperus rotundus*) the three most pernicious weeds of South India. The carbamate group of chemicals may solve this problem and work has just direction started in this been.

Recent literature and work has been largely centred on the use of synthetic growth-regulating substances for herbicidal purposes, with particular reference to the methods by which weeds might be eliminated without the treatment having any toxic effect either on the soil or on the crop. Chemical control of weeds is still new to India and from the advertisements one gains the impression that 2·4-D is a long-sought panacea to solve the farmer's problem overnight. Work in India, has just now started and at this stage it is too premature to advocate their use. Intensive trials under tropical conditions must first be conducted. A given dose found successful in a particular country has often failed to prove so effective in other parts of the world.

The results of Pant Protection work in South India, and of India, within a very short time with war inventions like D.D.T. and Gemmexane against insect pests, have testified to their efficacy and these preparations are now in great demand. The farmers have taken to these because of their striking success. In contrast, plant hormone weedkillers, released simulataneously by the same firms have not been put into use despite wide publicity. This indicates that under tropical conditions their behaviour and efficacy is variable or that the agriculturist is not keen on their use.

In western countries weed control is an acute problem caused by shortage of labour and mechanical means of control are preferred. This has incidentally helped the economic utilisation of herbicides with power dusters and sprayers, over large areas. In South India, the scattered nature of holdings, lack of equipment, high cost of herbicides and availability of human labour limit their popularity. In fact these factors have handicapped the spread of innovations of proved efficacy advocated by the Agricultural Department.

It has been found by several workers, that high temperature, sunshine and low humidity accelerate the efficacy of the hormones through increased transplantation in plants. Consequently in the tropics as in South India, crop resistance is also lowered. Vegetables as well as several crop plants are found to succumb to herbicides at doses intended for killing weeds. Even among cereals, resistance does not seem to be absolute. The sprayed crops were inhibited in growth and considerable time elapsed before they could recover. This can be attributed to the efficient translocation of herbicides in our conditions reducing the selective action attributed to them in colder regions.

In view of the risks involved, even on established crops, post-emergence treatments are to be avoided. As pre-emergent treatments their use has some scope in India. The toxic effects on soils have been indicated to persist for about a month with dosages at 5 and 10 p. p. m. roughly equivalent to 5 and 10 pounds of herbicides per acre. As the standard or optimum dosage does not exceed two pounds of any herbicide per acre, it is unlikely that the toxic effects will persist for longer periods than indicated. The preparatory cultivation, irrigation and after-cultivation will mitigate the residual effects of pre-emergence treatments. Intensive trials are therefore needed for garden, dry and wet land systems of cultivation in South India to evaluate their usefulness to control parasitic weeds like *Striga* sp, in Sorghum, Sugarcane etc. *Orobanche sp.* in tobacco, which take a heavy toll at present.

The two pernicious woods (*Cyperus rotundus*) and Hariali (*Cynodon dactylon*) have shown different degrees of immunity to all the derivatives of phenoxy-acetic acids; the former is found partly susceptible and the latter was immune. Several grasses, which are commonly found as pernicious weeds in this State are immune to these herbicides. Successive use of 2·4-D is reported by Crafts and Emanuelli (10) to lead to the extermination of susceptible ones and their replacement by resistant ones resulting in a worse situation than before. This aspect has to b viewed seriously and long-range work is necessary to study this aspect o e problem in weed control. A close corollary evidenced in the present time f is the development of resistant types of flies and ants through repeated use of D. D. T. Large areas of land which are newly brought under cultivation are found to provide favourable conditions for the spread of weeds. In a similar measure, any disturbance of natural balance through continued use of herbicides may lead to the perpetuation of resistant species, thus worsening the situation.

The natural factors, poor rainfall and low organic matter are conducive for the retention of herbicides for long periods. The Ceded Districts in South India, are unrivalled in these features. The use of herbicides in these tracts even as pre-emergence treatments is likely to be dangerous.

Herbicides even if effective are not likely to replace the existing methods of weed control. The present methods of weed control with implements and interculture are effective, simple and economical. Interculture aims at conservation of moisture along with weed control and prevents the formation of a soil pan, thereby checking soil erosion. Weedicides on the other hand, may not heip conservation of soil moisture nor check formation of soil pan or erosion processes. In general, cultivation has been the most successful line of attack due its beneficial effects on the soil. In the present state of our knowledge concerning chemical weed control, it would be premature to advocate their use on large areas of arable land especially where cultivation can do the work.

For the present, herbicides for control of weeds, along highways, rail tracts, playgrounds and for clearance of weeds in newly proposed projects are practicable. As long as the cost remains at the present level, they may not become popular even for these purposes. Where prompt eradication will prevent the spread of noxious weeds like water hyacinth—*Eicchornia crassipes*, the use of herbicides should be encouraged. In other fields extensive research is needed before they are advocated. Their use in South India definitely requires caution at the present juncture.

SUMMARY.

1. Chemical control of weeds through herbicides have claimed world-wide interest as well as publicity. In India large-scale trials are yet to be conducted.
2. A brief review of literature on weed control, with growth regulating substances as herbicides has been presented, indicating the work on susceptible, resistant weeds, their action on crops, mode of use, method of treatment, effect on soil etc.
3. A need for survey of weeds and crops in India is indicated.
4. All South Indian vegetables as a rule are highly susceptible to phenoxy acetic acid derivatives and in such crops their use is not recommended.
5. Most crop plants including cereals, considered resistant to herbicides are found partly susceptible under South Indian conditions probably through increased absorption and translocation under our conditions, thus diminishing their selective properties.
6. *Cyperus rotundus* (nut grass) is only partly susceptible to herbicides and is not killed or eradicated as claimed by several workers and commercial firms, under our conditions as the under-ground parts are not destroyed even at high concentrations.
7. The grasses in temperate countries are found to have a high degree of resistance. In South India, though they are injured in their aerial portions, they persist through their underground parts.

8. With the derivatives of phenoxy-acetic acids, the soil is found to lose its toxicity in a month's time if the concentration does not exceed 5 p. p. m.

9. In the absence of rain or cultivation the toxic effects last longer even if minimum quantities are used.

10. Arid tracts like the Ceded Districts are unsuitable for extension of weed control with herbicides.

11. Pre-emergence treatments have possibilities for control of parasitic weeds like Striga sp. in Sorghum, Sugarcane etc. and Orabanche in tobacco. Their possibilities have to be explored.

12. Herbicides cannot be recommended at this juncture for weed control in arable lands in South India, even though foreign work and commercial publicity are in their favour.

ACKNOWLEDGMENT.

The author is grateful to P. Venkatramiah, M. A., B. SC., (Edin.) Principal, Agricultural College, Bapatla and to the Department of Agriculture, Madras for the grant of all facilities.

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Cotton Raw, in the Madras Presidency: All figures are in bales of 392 lbs. The receipt of loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1950 to 13—10—1950 amounted to 2,83,698 bales of 392 lb. lint. The receipts in the corresponding period of the previous year were 3,45,988 bales. 3,71,227 bales mainly of pressed cotton were received at spinning mills and 16,404 bales were exported by sea while 1,31,330 bales were imported by sea mainly from Karachi and Bombay. (Director of Agriculture, Madras)

Weather Review — For September 1950

RAINFALL DATA

Division	Station	Total for the month in inches	Departure from normal in inches	Total since January 1st in inches
Orissa & Circars.	Gopalpur	3·4	—4·1	33·1(x)
	Calingapatnam	1·5	—5·4	20·8
	Vishakhapatnam	5·7	—0·9	21 7
	Anakapalle*	5·8	—0·9	22·8
	Samalkot*	10·5	+4 3	30 3
	Kakinada	5·7	—0 5	24·1
	Maruteru*	20 3	+15·0	43·3
	Masulipatnam	10·4	+4·0	28·4
	Guntur*	5·8	+0·4	26·0
	Agrl. College, Bapatla*	8·9	+1·7	24·1
	Rentachintala	7·2	+6·4	18·5
Ceded Dists.	Kurnool	6·1	+0·1	26·2
	Nandyal*	7·1	+0·7	21·9
	Hagari*	3·6	—1·2	14·8
	Siruguppa*	5·8	-0·6(a)	17 2
	Bellary	2·3	—2·6	14·0
	Cuddapah	6·3	+0·3	15·2
	Kodur*	3 5	—0·1	11·8
Carnatic.	Nellore	7·0	+2·5	17·8
	Buchireddipalem*	6·6	+2·6	15·2
	Madras (Meenambakkam)	7·0	+2·3	24·4
	Tirurkuppam*	6·1	-0·9@	19·9
	Palur*	3·0	—4·6	18 2
	Tindivanam*	5·4	—0·8	15·4
	Cuddalore	3·7	—1·5	15·8
Central.	Vellore	5·1	—1·8	15·3
	Gudiyatham*	4·4	—0·4	11·2
	Salem	4·0	—2·1	21·3
	Coimbatore (A. C. R. I.)*	3.5	+1·5	13·1
Central-*Contd.*	Coimbatore (C. B. S.)*	3·4	+1·8	13·2
	Coimbatore	2·2	+0·6	10·5
	Tiruchirapalli	2·2	—1·8	17·4
South.	Nagapattinam	4·3	+1·0	19·5
	Aduturai*	4·3	+0·2	18·3
	Pattukottai*	2·1	—2·2	18·9
	Mathurai	0·4	—4·3	20·3
	Pamban	Nil	—1·1	8·7
	Koilpatti*	0·5	—2·1	12·3
	Palayamcottai	0·2	—1·0	10·8
	Ambasamudram*	1·3	+0·2	15·1
West Coast.	Trivandrum	9·1	+4·6	52·1
	Fort Cochin	16 9	+9·2	115·9
	Pattambi*	10·7	+6·1	144·0
	Taliparamba*	16·6	+7·4	140·7
	Nileshwar*	33·8	+23·2	167 2
	Pilicode*	22·0	+11 7@	138·5
	Mangalore	23·1	+13·7	139·4
	Kankanady*	23·8	+13·4	142·2
Mysore & Coorg.	Chitaldrug	5·6	+1·2	18·2
	Bangalore	4·3	—2·4	17·3
	Mysore	2·5	—2·5	21·2
	Mercara	27·4	+16 3	126 9
Hills.	Kodaikanal	3·3	—4·0	33·0
	Coonoor*	1·7	—2·0	28·1
	Ootacamund*	3·3	—1·3	29 7
	Nanjanad*	6·5	+1·4	44·5

Note:—

(1) * Meteorological Stations of the Madras Agricultural Department.

(2) Average of ten years data is taken as the normal.

(3) @ Average of seven years data for Tirurkuppam and eight years data for Pilicode is given as normal.

(4) (a) Taluk office normal is 6·50" and rainfall is 5·71".

(5) (x) Data pertaining to 30—9—1950 are not available in the report of that date.

Weather Review for September, 1950.

The month commenced with an active monsoon in northern India, the central parts of the country, Gujarat, the Konkan and Malabar-South Kanara. A low pressure wave travelling westwards across Tenasserim on 2—9—1950 strengthened the monsoon in the Bay of Bengal, south of Lat. 13 N. On 4—9—1950 the Bay of Bengal brach of monsoon became weak.

Conditions were markedly unsettled in the Bay of Bengal on 8—9—1950 and later a depression was formed and due to this depression, widespread and locally heavy rains occurred in a number of places in the southern districts of Coastal Andhradesa, Malabar and South Kanara on 10—9—1950. The next day this depression became weak.

The deep depression at the head of the Bay of Bengal intensified further on 13—9—1950 and developed into a small cyclonic storm centred at 03 hours G.M.T. about 60 miles south-east of Balasore in Orissa. Along with this storm there had been not only a general revival of the monsoon over the country outside North West India, but also widespread rains along the West Coast. The next day the storm became weak after striking the Orissa Coast south of Balasore.

On 15—9—1950 the monsoon became strong in the South-east Arabian Sea, off the Malabar Coast. Till 20—9—1950 a deep depression was noted in some part or other over Rajasthan. On 21—9—1950 the Monsoon withdrew from the Punjab (I), Rajasthan and the adjoining parts of West Uttar Pradesh.

On 27—9—1950 the monsoon withdrew from Madhya Pradesh, Bihar, Chota Nagpur, West Bengal and Orissa and is withdrawing from the northern half of the Pennsula. A low pressure wave was found moving westwards across central Burma on 28—9—1950. The next day the monsoon withdrew from the country except from the extreme south of the Peninsula.

There is nothing worth recording regarding the variations in day temperatures.

Particulars about the zonal rainfall in the Madras State and noteworthy falls in the month are given hereunder :—

Serial No.	Name of Zone.	Total Precipitation.
1	Orissa and Circars	Above normal
2	Ceded Districts	Just below normal
3	Carnatic	Just Normal
4.	Central	do.
5	South	Below Normal
6	West Coast	Far above normal
7	Mysore and Coorg	Except Coorg, rest just below normal
8	Hills	Below Normal

Note-worthy Falls.

Serial No.	Date.	Place.	Rainfall in inches in a period of 24 hours.
1	10—9—50	Masulipatam	4·5
2	do.	Rentachintala	3·3
3	14—9—50	Mercara	3·6
4	23—9—50	Madras (Nungambakam)	3·3
5	26—9—50	Coimbatore (Air field)	4·6
6	28—9—50	Alleppey	4·8
7	30—9—50	Chitaldrug	3·0

Agricultural Meteorology Section,
Lawley Road Post, Coimbatore
Dated, 14—10—1950.

M. B. V. N., C. B. M., & M. V. J.

Departmental Notifications

Gazetted Service — Postings and Transfers

Names	From	To
Sri Jivan Rao, M.	Asst. Marketing Officer,	D. A. O., Cuddapah.
„ Parameswara Menon, P. K.	D. A. O., Cuddapah,	Addl. D. A. O., Calicut.
„ Sadasiva Rao, B. K.	Asst. Agrl. Engineer, Madras,	Asst. Agrl. Engineer, (Civil) Coimbatore.
„ Satyanarayana murthi, K.	Asst. in Cotton, Bellary,	Asst. Cotton Specialist, Siruguppa.

SUBORDINATE SERVICE

Postings and Transfers

Names	From	To
Sri Appa Rao, S.	On leave,	A. D., Amalapuram.
„ Arasappan, S.	Special A. D.,	Special A. D., Mathurai.
„ Channabasaviah,	F. M. Sugarcane Liasion Farm, Hospet.	A. D., Cuddapah.
„ Ebeneser, J.	Addl. A. D., Madurantagam,	A. D., Chingleput.
„ Guruswami, V. D.	A. D., Paramakudi,	Asst. in Cotton, Koilpatti.
„ Krishnan, S.	Addl. A. D., Madurantagam,	Asst. in Chemistry, Coimbatore.
„ Kolandavelu Naicker, R.	On leave,	A. D., Madurantagam.
„ Krishna Iyer, C. S.	Asst. Meteorology, Koilpatti,	Cotton Asst., Periakulam.
„ Kunhiraman Menon, P.	Soil Survey Officer. Bellary,	Asst. in Chemistry, Coimbatore.
„ Moorthi Raju, K.	On leave,	Paddy Asst., Buchireddi.
„ Murugesan, G.	Teaching Asst. in Agrl., Coimbatore,	Special A. D., Koilpatti.
„ Narasimha Rao, I. L.	Seed Develop. Asst., Eluru,	Seed Develop. Asst., Anakapalli.

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,, Ramalingeswara Rao, M.	On leave,	Asst. in Oil Seeds, A. R. S., Tindivanam.
,, Radhakrishna Menon, K.	Asst. in Oil Seeds, A. R. S., Tindivanam,	Addl. A. D., Pattambi.
,, Raghavachari, R.	Fieldman,	Special A.D., Chidambaram.
,, Raghunatha Reddi, D.	Soil Conservation Asst., Bellary,	Addl. A. D., Kalladakurichi.
,, Rajagopalan, D. S.	Addl. A. D., Devakottai,	Special A. D., Koilpatti.
,, Subba Naidu, T.	Special A. D.,	Special A. D., Melur.
,, Srinivasa Rao, K.	Asst. in Cotton, A. R. S.,	Special A. D., Avanigadda.
,, Srinivasan, T.	On leave,	Teaching Asst. in Agrl. Coimbatore.
,, Sargunam David Peter,	Addl. A. D., Dindigul,	A. D., Thirumangalam.
,, Sankaranarayanan, R.	Cotton Asst., A. R S., Koilpatti,	Asst. in Meteorology, Koilpatti.
,, Valainai Naidu, K.	Seed Develop. Asst. Anakapalle,	Seed Develop. Asst. Periakulam.
,, Veerabhadra Rao, V.	On leave,	Addl. A. D., Narasapatam.

APPOINTMENTS

Sri Dondu Rao, S.	Asst. in Meteorology Section, Coimbatore.
,, Ramakrishna Sarma, V.	F. M. Live Stock Farm, Koila.
,, Ramanujam, K.	Botany Asst., Coimbatore.

Agricultural College and Research Institute, Coimbatore

LIST OF ADDITIONS TO LIBRARY FOR SEPTEMBER; 1950.

1. COOKE (F. C.): Pineapple Industry of the Hawaiian Islands, 1949. Depart. Agri. Federated, Malaya.
2. GOTES (Frank, C.): Field manual of Plant Ecology, 1949. McGraw Hill Book Co.
3. GOODE (J. S.) and RUDDUCK (H. B.): Ed. Artificial insemination of farm animals in the Soviet Union, 1948. Angus and Robertson, London.
4. MAC DOUGALL and HAGNER: Biology Science of Life, 1943. McGraw Hill Book Co.
5. Moore (H. I.): Background to farming, 1947. George Allen and Unwin, Ltd.
6. MOORE (H. I): Crops and Cropping, 4th Edn. 1950. George Allen and Unwin, Ltd.
7. MOORE (H. I.): Good husbandry, 1948. George Allen and Unwin, Ltd.
8. MOORE (H. I.): Grassland husbandry, 4th Edn. 1950. George Allen and Unwin, Ltd.
9. PRANAVANANDA: Kailas Manasarovar, 1949. S. P. League, Calcutta.
10. PURI (A. N.): Soils, their Physics and Chemistry, 1949. Reinhold Publishing Corporation.

T. S. R.

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