https://doi.org/10.29321/MAJ.10.A04001

Studies on the germinating Groundnut seed (TMV. 2) in Red and Black Soils treated with Micro-Nutrients*

by

S. GOPALAKRISHNAN[1] and L. VEERANNAH[2]

Synopsis: Biochemical studies on the germinating groundnut seeds raised in the red and black soils treated with micro-nutrients like boron, copper, manganese, zinc and molybdenum made under pot culture conditions are reported in this paper.

Introduction: Biochemical studies on germination of seeds in general and groundnut in particular have been carried out by various workers. With particular reference to oilseed, Sahasrabuddhe and Kale (1933) had studied the metabolism of fat in the niger seed. As early as 1842, Desaussure observed the diminishing of oil during the germination of rape and hemp seeds. Miller (1910 & 1912) found that oils in sunflower diminished as germination progressed. It is well known that oil is split up into glycerine and fatty acids, to start with and the fatty acids are further oxidised to carbon dioxide and water. Synthesis of sugar from fat is also made possible due to the common point of junction in the pathways of fat and carbohydrate metabolism. The chemical process of germination is obviously different according as the seeds are starchy, proteinaceous or fatty. The metabolic changes are likely to be modified under various factors obtaining in soils during germination. Apart from the types of soils that contribute to the fluctuation, the effect of added micro-nutrients that participate in the characteristic oxidation-reduction mechanism of the enzyme system was sought to be assessed.

Material and methods: Investigations were carried out under red and black soils under pot culture conditions. Thirty-six earthen-ware pots 10″ × 10″ containing fifteen kilograms of soil of particle size two mm. were utilized. There were six treatments in all viz., control, boron, zinc, manganese, copper and molybdenum. Trace elements were thoroughly mixed with soil and the soil was irrigated to a sticky point including that of control. Copper, manganese and zinc were applied as sulphates at the rate of 10 lb. per acre, boron as boric acid at the rate of 10 lb. per acre and molybdenum as sodium molybdate at the rate of 2 lb. per acre. During incorporation with the soil, micro-nutrient salts were calculated on an arbitrary basis of 30,000 pots per acre. The bunch strain TMV. 2 was used

* Received for publication on 11—7—1962.

1. Plant Physiologist, Agricultural College and Research Institute, Coimbatore-3.
2. Assistant in Plant Physiology, Agricultural College and Research Institute, Coimbatore-3.

for the investigations and fifty seeds were weighed and dibbled in each pot, the day after the application of micro-nutrients. Ten of the germinating seeds from the pots were removed completely on the first, second, third, fourth and fifth day after sowing and the batches were analysed for free fatty acid content from the oil expressed out of these samples. Data were also collected on the ether extractive, dry matter production, radicle length etc., from the samples drawn on the second, fourth, sixth, eighth and tenth day of germination.

Results and discussion : The data of observation are presented in tables I to IV. The trend of the values against time is represented in different graphs for free fatty acid, percentage of ether extractives, dry matter and length of radicle (Graphs I to IV).

TABLE I.

Length of radicle in cm. (Average of 10 germinating seeds)

Date of sowing : 15—4—1961.

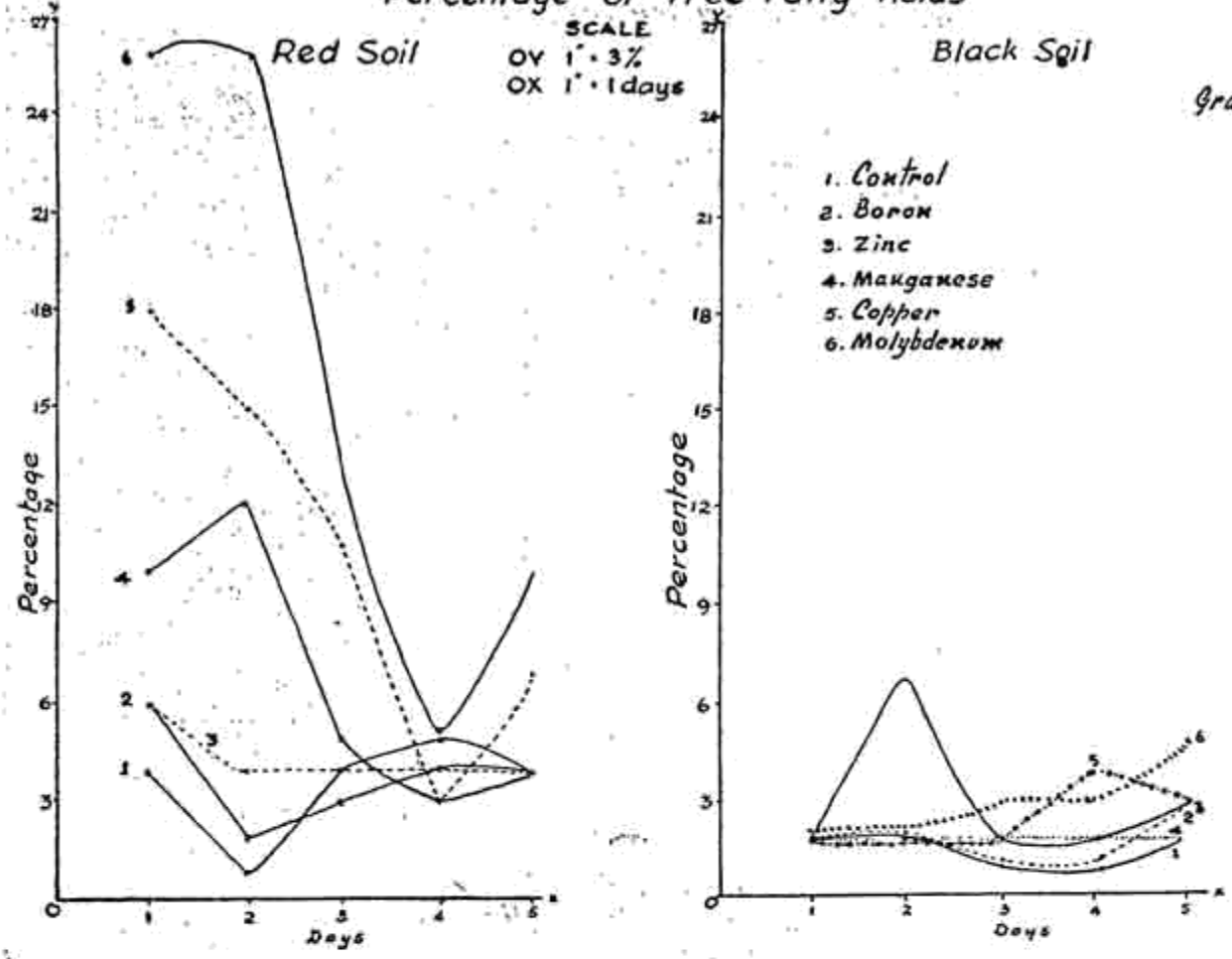
Treatment	RED SOIL					BLACK SOIL				
	17-4-'61	19-4-'61	21-4-'61	23-4-'61	25-4-'61	17-4-'61	19-4-'61	21-4-'61	23-4-'61	25-4-'61
Control	0·24	4·32	5·00	5·77	7·38	1·15	4·64	4·74	6·90	5·96
Boron	0·76	4·20	5·82	7·33	7·27	1·31	6·07	4·17	7·46	6·17
Zinc	0·37	5·41	5·70	5·47	6·43	0·93	5·48	4·49	6·95	6·04
Manganese	0·28	0·66	4·38	6·05	7·20	1·28	6·88	5·98	6·71	5·67
Copper	0·87	1·80	5·49	6·44	8·54	1·00	6·48	5·27	6·43	5·95
Molybdenum	0·68	4·30	4·42	7·21	7·23	1·48	7·40	5·42	5·86	6·30

TABLE II.

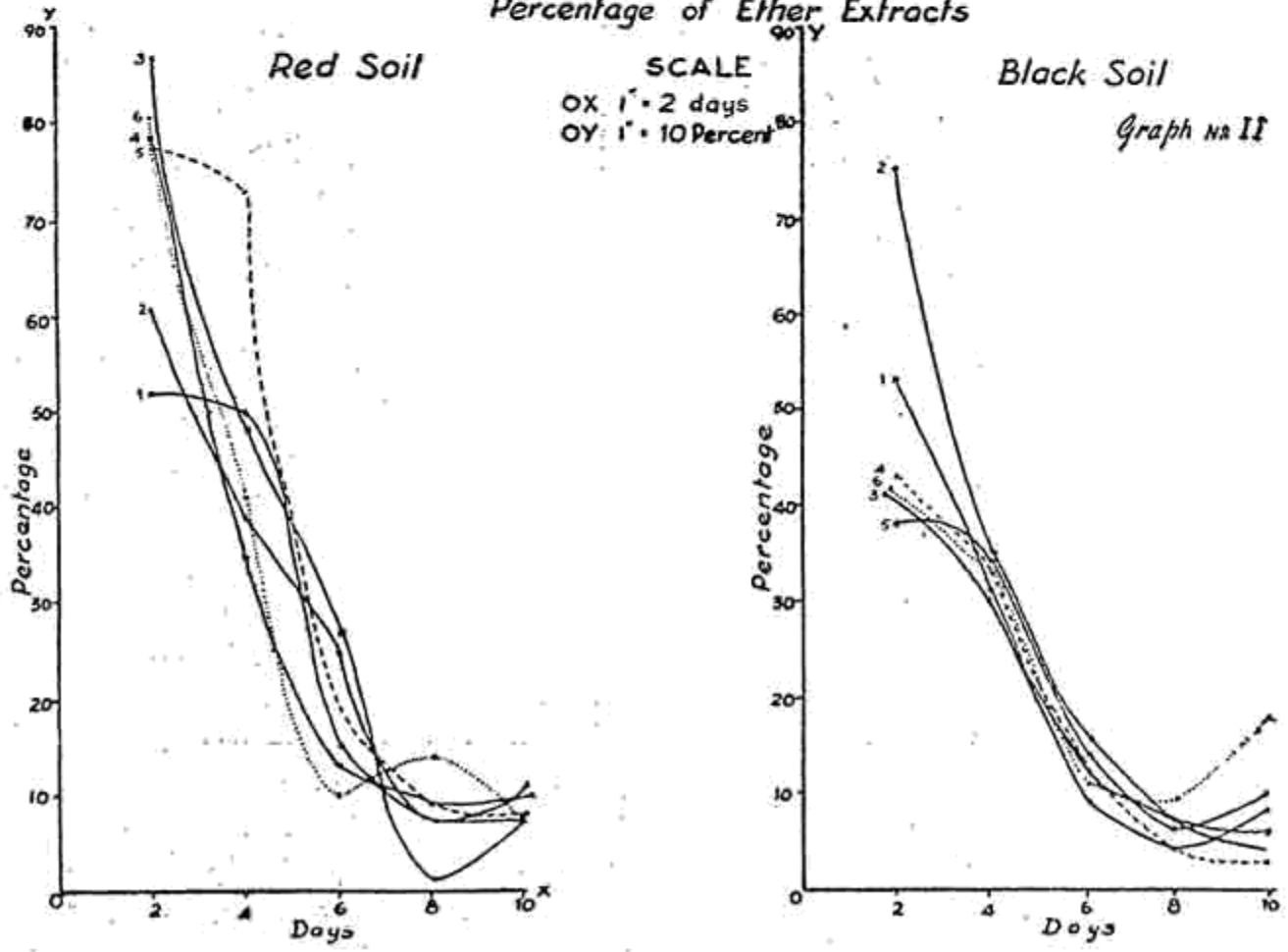
Percentage of Ether extracts in Groundnut seeds TMV. 2 (Bunch)

Treatment	17-4-'61	19-4-'61	21-4-'61	23-4-'61	25-4-'61	17-4-'61	19-4-'61	21-4-'61	23-4-'61	25-4-'61
Control	52·72	50·23	15·52	7·18	7·46	53·35	31·32	9·53	4·41	8·00
Boron	61·31	39·68	25·57	7·59	10·91	75·70	35·31	15·70	7·09	4·63
Zinc	87·04	35·36	13·99	9·15	10·16	40·37	30·80	12·69	7·08	6·66
Manganese	79·38	48·20	27·46	1·88	7·82	43·68	33·98	12·01	4·98	3·92
Copper	77·76	73·79	19·12	9·37	8·56	38·65	34·75	14·78	6·62	10·75
Molybdenum	81·76	41·37	10·86	14·05	7·13	41·50	33·95	11·91	9·72	18·38

Groundnut TMV. 2
Percentage of Free Fatty Acids

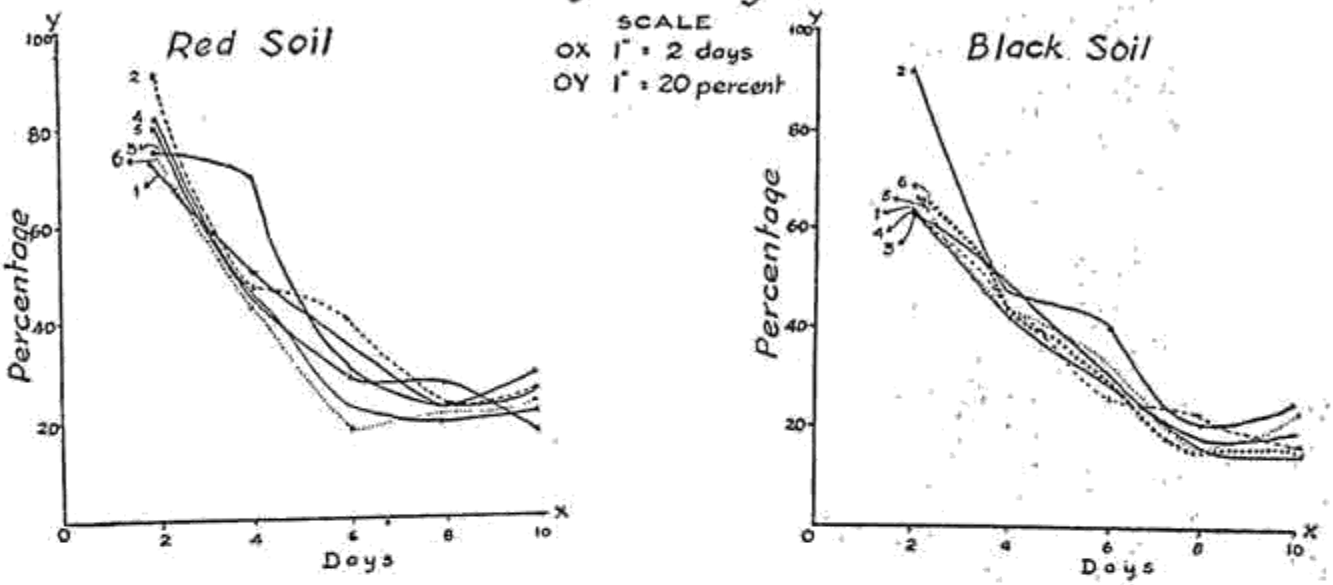


Groundnut TMV. 2
Percentage of Ether Extracts

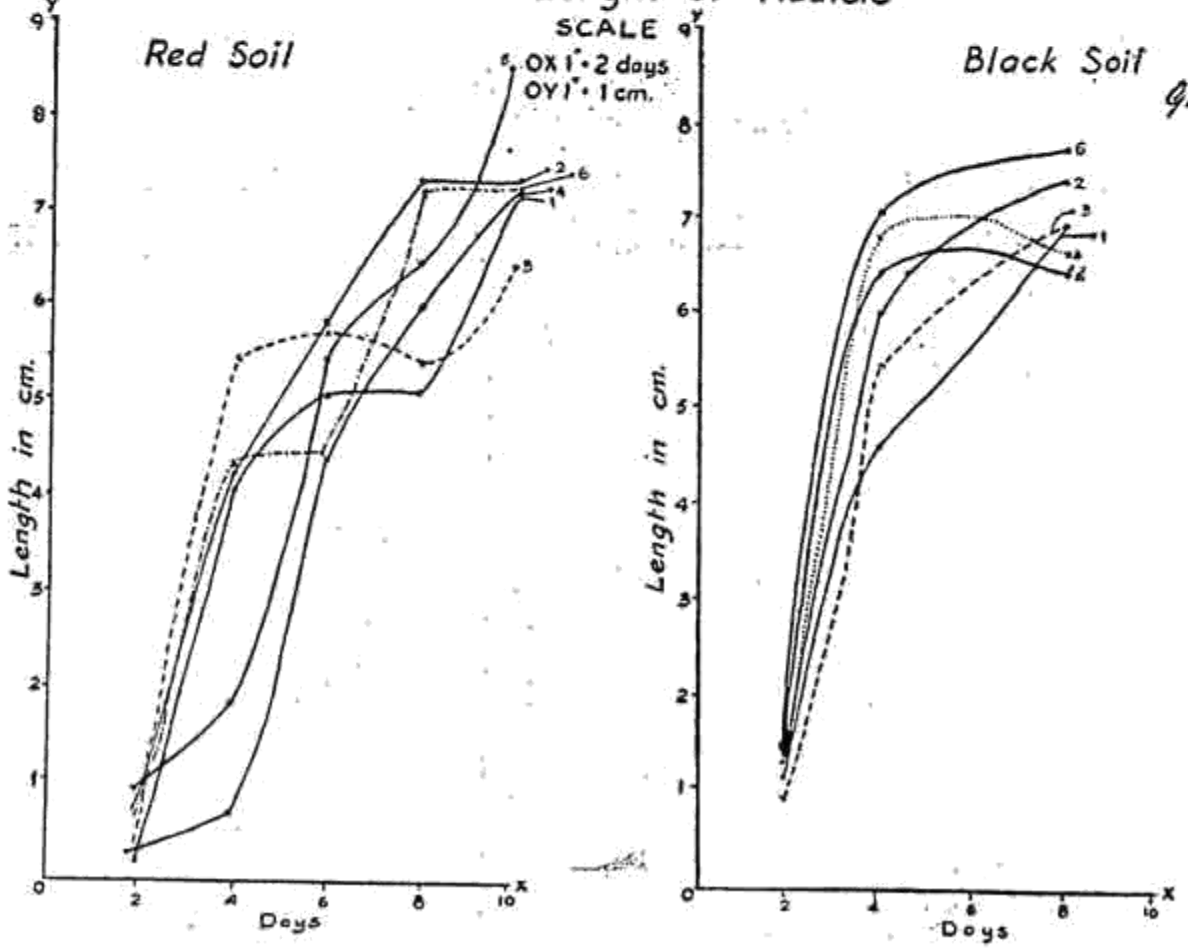


Graph No III

Groundnut T.M.V. 2.
Percentage of Dry Matter



Groundnut TMV.2
Length of Radicle



Graph No IV

TABLE III.

Percentage of free fatty acids in Groundnut TMV. 2 (Average of 10 germinating seeds)

Date of sowing: 5—5—1961

Treatments	RED SOIL					BLACK SOIL				
	6-5-'61	7-5-'61	8-5-'61	9-5-'61	10-5-'61	6-5-'61	7-5-'61	8-5-'61	9-5-'61	10-5-'61
Control	4·38	0·85	4·26	5·55	4·43	2·47	2·74	1·72	1·76	2·96
Boron	6·55	2·19	3·07	4·34	3·89	2·56	2·92	1·79	1·85	3·30
Zinc	6·59	4·61	3·80	3·87	4·23	2·53	7·94	2·05	2·14	3·40
Manganese	10·09	12·74	5·50	3·26	4·84	2·82	2·61	2·33	2·62	2·72
Copper	18·91	15·48	11·51	3 70	7·14	2·96	2·69	2·54	4·68	3·68
Molybdenum	26·71	26·17	13·43	5·70	10·77	2·91	2·76	3·11	3·66	5·71

TABLE IV.

Percentage of dry weights

Treatments	RED SOIL					BLACK SOIL				
	17-4-'61	19-4-'61	21-4-'61	23-4-'61	25-4-'61	17-4-'61	19-4-'61	21-4-'61	23-4-'61	25-4-'61
Control	73·30	50·14	35·22	21·00	25·84	64·52	41·29	29·91	18·60	19·13
Boron	91·68	47·36	40·39	21·59	25·33	92·10	47·36	40·39	21·59	25·33
Zinc	75·25	50·25	30·87	22·15	28·86	63·57	48·01	30·84	16·90	17·72
Manganese	82·99	44·70	39·20	27·99	17·48	64·52	45·42	26·89	21·74	17·44
Copper	75·28	43·40	18·68	22·43	23·78	68·06	44·19	32·81	15·19	23·22
Molybdenum	80·63	44·81	22·24	19·34	21·27	67·97	44·24	32·06	16·42	16·87

Free fatty acid: The free fatty acid content of oils expressed out of samples drawn from the germinating seeds in red soil in contrast to black soil has been remarkably high - nine, six and three times in the case of molybdenum, copper and manganese treatments respectively. However, neither boron nor zinc had any considerable effect or difference in free fatty acid content between the two types of soils. The initial surge in the free fatty acid content had a steep decline and the values got evened out after the fourth day. There was also a tendency for a further rise afterwards in the case of copper and molybdenum.

It is well known that the micro-nutrient availability is largely controlled by soil pH (Sandal 1944 and Ignatiff and Page 1958) and with the characteristic difference in pH between red (pH 6·5) and black (pH 8·8) soils,

the micro-nutrients had been immobilised. Thus manganese, copper and molybdenum were somewhat effective in the enzyme activity in the germinating seed and increased the oxidative rancidity (Bailey 1948). Boron and zinc being amphoteric, they were not effective even in red soils.

The rapid decline in the free fatty acid may perhaps be attributed to the preferential utilisation of unsaturated fractions of free fatty acids during fat metabolism of the germinating seed. Thus the rapid decline of free fatty acid in fat metabolism in germinating seed presents an interesting feature and it is to be investigated alongside the duration of availability of the applied micro-nutrients in the different soil types. It is also to be investigated over the respective saturated and unsaturated free fatty acid units due to micro-nutrients applications.

Ether extractives : The conversion and utilization of oil has been quite rapid as denoted by the deep decline in the ether extractive values and by the eighth day it reaches the minimum level. There does not appear to be much difference in the trend in the loss of oil in the germinating seeds, in red and black soils. However, it may be observed that there is a slight difference in the decline of ether extractives due to various micro-nutrients in the two types of soils, though the effect is not the same. Copper appears to have a modulating effect on the decline of ether extractives. The distinctly high values of ether extractives in various treatments over control on the second day of germination would go to show that the effect of micro-nutrients in the nature of enzyme activity has effected the depletion of carbohydrate reserves during respiration and this is significant in red soil.

Dry matter : The fall in the percentage of dry matter with the course of time has been similar in both red and black soils although there is a slight difference due to treatments. However, boron seems to have increased the dry matter to a slight degree probably by increasing the carbohydrate content.

Radicle length : The effect of micro-nutrients on the length of radicle has been characterised to an extent by the role and function of different micro-nutrients. Zinc and molybdenum, particularly the former has accelerated in radicle growth. It is probable that zinc as a member of prosthetic group of the enzyme in the formation of indole-acetic acid, has effected marked elongation of the radicle

Summary and Conclusion : Biochemical studies on the germinating groundnut seeds raised in red and black soils that had been treated with micro-nutrients like boron, copper, manganese, zinc and molybdenum were

made under pot-culture conditions. The bunch strain TMV. 2 was used and samples were taken upto ten days and the free fatty acids, ether extractives, dry matter status etc. were evaluated. The availability of micro-nutrients in red soil rather than black soil was clearly indicated by the biochemical changes in the germinating seed. An initial surge in free fatty acid content due to molybdenum, manganese and copper in the red soil was remarkable while boron and zinc were not effective. The differential decline in ether extractives due to various micro-nutrients was brought out.

Acknowledgment: The authors wish to acknowledge the facilities and encouragement extended by Sri S. G. Aiyadurai, Oilseeds Specialist in carrying out the studies.

REFERENCES

Bailey, A. E. 1948 Cotton and cotton seed products, their chemistry and chemical technology. *Inter. Sci. Pubn., Inc. New York.*

Desaussure, T. 1842 Changes in the fats and fatty oils during germination. *Uber das Keimen der Oelsamereion Froriep's Notizen*, **24**: 24.

Ignatiff, V. and Harold, J. Page 1958 Efficient use of fertilizers. **43**. *FAO Agric. Studies.*

Miller, E. C. 1910 A physiological study of the germination of Helianthus. *Ann. Bot.* **24**: 693–726.

——— 1912 A physiological study of the germination of *Helianthus annus* 11, The oily reserve. *Ibid.* **26**: 889–901.

Sahasrabuddhe, D. L. and N. P. Kale 1933 A biochemical study of the formation of the oil in Niger seed. *Indian. J. Agric. Sci.* **V**: 57.

Sandal, E. B. 1944 Calorimetric determination of trace of metals III. *Intcr. Sci. pubn. Inc. New York.*