https://doi.org/10.29321/MAJ.10.A03293

Madras agric. J. 63 (4): 219—223, April, 1976.

Chlorotic Phenomenon in Groundnut

By

S. GOPALAKRISHNAN [1] and P. S. SRINIVASAN [2]

ABSTRACT

Chlorosis caused by poor drainage is compared with that caused by mineral deficiencies of N, S or Fe. Chlorotic symptoms of the foliage manifest on the 60th day. But estimation of chlorophyll shows a decrease much earlier even in 30 days. Sulphur and iron deficiencies are not severe. Carbohydrate status is more disturbed than nitrogen. The poor drainage situation causes a reduction in yield of pods by 30.6 per cent from control and oil content by 3.2 per cent.

NTRODUCTION

The occurrence of chlorosis is a common phenomenon in groundnut with conditions of poor drainage though occasionally it is manifested due to other causes as well. The effect of chlorosis in the groundnut variety—TMV$_2$ under different conditions providing a complete nutrient medium as well as deficient nutrient medium conditions, has been studied and the results reported in this paper.

MATERIALS AND METHODS

The TMV$_2$—groundnut variety was raised in plastic containers in sand cultures and irrigated with 500 ml of Arnon and Hoagland culture solution every three days. The composition of the solution was suitably adjusted so as to provide complete, minus nitrogen, minus sulphur and minus iron conditions. An additional treatment of "poor drainage" was also provided to simulate waterlogged condition occurring in the field. Top and bottom leaf samples were collected, and estimations of chlorophyll (spectrophotometric), nitrogen (total and soluble) and sugar (total and reducing) (colorimetric) were made on samples drawn on 30, 45 and 60 days. Pod yield and oil content were also determined.

RESULTS AND DISCUSSION

Chlorophyll content: The content is lowered in all the treatments as compared to control and the differences among the treatments were noticeable prominently on the 60th day as a foliar symptom. When comparison of values of both top and bottom leaves is made, the top leaves showed much variation with respect to the three components. Eventhough the symptoms of deficiency of N, S and Fe are to be looked for at different zones by virtue of their mobility, the top leaf analysis reflects sufficiently the disturbed physiological condition. Irrespective of the severity of chlorotic symptoms due to various nutrient element deficiency the top young leaves are to be evaluated, being the active sites. Any nutrient deficiency affects protein synthesis and as such the active young top leaves are considered for the altered physiology. A

1, 2. Department of Plant Physiology, Tamil Nadu Agricultural University, Coimbatore - 641003.

deficiency of nitrogen and poor drainage conditions have shown their impact when the values are as low as 8.4 and 45.7 per cent of control respectively by 30th day. Sulphur and iron deficiencies do not appear to reduce the chlorophyll content to such a marked degree. Chlorophyll estimations have, however, indicated an appreciable reduction to 85.0 and 82.2 per cent of control as early as 30 days which is further reduced to 64.7 and 61.5 per cent of control respectively on the 60th day (Table I).

That N, S and Fe are intimately associated in chlorophyll synthesis is too well known to mention but the degree of severity and time of their occurrence in a crop such as groundnut provides interest. In fact it has been shown that in groundnut, symptoms of deficiency could be produced sufficiently early using excised embryos as seed reserves are larger enough to overcome early stress of nutrient deficiency (Gopalakrishnan and Nagarajan, 1958).

Sugar content: Both the bottom and top leaves reflect the disturbed reducing and total sugar status. A consideration of the values for top young leaves indicates that the four treatments fall into two categories viz. poor drainage and N deficiency on the one hand and S and Fe deficiency on the other. A deficiency of N as well as poor drainage conditions tend to increase both reducing and total sugar content while such a trend is not noticeable in the case of either S or Fe deficiency wherever a slight decrease could be noticed.

Nitrogen content: In this case also both bottom and top leaves show altered status. Soluble nitrogen is higher in all the treatments while the total nitrogen is lower as compared to control. For a clear appreciation of the disturbed metabolism of both carbohydrate and nitrogen, the values expressed as percentage increase or decrease over control at different stages *viz.*, 30, 45 and 60 days were considered. Soluble N increased due to poor drainage or nutrient deficiency. But total N decreased with reference to control. However, N status is similar in trend irrespective of nutrient deficiency or poor drainage. But sugar status shows difference in trend. Accordingly the treatments may be classified into two groups *viz.* poor drainage and minus N on the one hand and minus S and minus Fe on the other. Both reducing and total sugars accumulated due to poor drainage and N deficiency but they are somewhat lowered under the stress of S or Fe deficiency.

The findings in the present investigations are generally in agreement with other contributions. As far as N deficiency is concerned an increase in α amino nitrogen with reference to control is well established in many crop plants (Steinberg *et al.*, 1956), though the quantum of variation concerns the degree of severity of deficiency. For instance an increase of 38 per cent in α-amino nitrogen due to medium nitrogen deficiency in barley (Gregory and Baptiste, 1936) and 41 per cent due to severe nitrogen deficiency in barley (Richards and Templemen, 1936) were reported. The

TABLE I. Effect of poor drainage and deficiency of nutritional elements on chlorophyll, sugar, and nitrogen contents.

Treatment	Days	Chlorophyll (mg/g)		Sugar (mg/g)				Nitrogen (mg/g)			
				Top		Bottom		Top		Bottom	
		Top	Bottom	Reducing	Total	Reducing	Total	Soluble	Total	Soluble	Total
Control	30	1.07	0.95	17.3	184	17.1	178	7.0	36.0	6.5	35.2
	45	1.02	0.94	16.9	180	16.8	180	7.8	35.8	7.8	35.0
	60	0.88	0.88	16.5	176	16.5	171	7.8	35.6	7.7	34.8
— N	30	0.09	0.09	19.5	210	15.0	201	8.9	31.8	8.0	31.4
	45	0.07	0.07	18.8	200	18.6	194	9.2	31.6	9.2	31.2
	60	0.05	0.05	17.3	185	18.0	188	8.9	31.0	9.0	30.8
— S	30	0.91	0.99	17.3	184	17.1	173	8.6	33.6	7.2	33.6
	45	0.77	0.57	17.0	180	16.6	168	8.6	32.6	8.0	33.2
	60	0.57	0.56	16.5	176	16.7	170	8.6	32.2	8.0	32.8
— Fe	30	0.88	0.92	17.1	182	17.0	172	8.4	32.6	7.4	32.2
	45	0.83	0.89	17.0	180	17.0	172	8.6	32.2	8.8	32.2
	60	0.54	0.53	16.0	170	16.9	171	8.7	32.0	8.6	32.0
Poor Drainage	30	0.49	0.49	18.8	195	18.7	192	8.8	32.0	7.8	31.6
	45	0.37	0.37	17.8	185	17.7	183	9.0	31.8	8.8	31.4
	60	0.23	0.23	17.0	177	17.3	177	8.8	31.2	8.8	31.0

same authors have reported a reduction in protein nitrogen. Tobacco also presents an increased α-amino nitrogen status to an extent of 32 per cent under severe nitrogen deficiency (Steinberg *et al.* 1956). Effects of sulphur deficiency on α-amino nitrogen also appear to be uniform. In the case of soybean, a medium deficiency increases α-amino nitrogen to an extent of 15 per cent. But protein nitrogen is decreased by 13 per cent (Eaton, 1935). Fe deficiency also tends to reduce protein nitrogen (Bennet, 1945). Similarly the effect of nutrient deficiency on sugar status finds ample evidence in support. An increase of eight per cent in reducing sugar in barley (Gregory and Baptiste, 1936) without a similar increase in total sugar, an increase of as much as 55 per cent in total carbohydrate in tomato (Janssen et *al.* 1934), a reduction in reducing sugars and total sugar in soybean to S deficiency by 16 per cent (Eaton, 1935) have been reported. The rate of Fe in reducing sugar content would appear as tied up with the form of N, as instanced in pine apple (Sideris and Young, 1944). With ammonium nitrogen as N source a reduction is met with, whereas, nitrate nitrogen tends to increase it slightly. However, in both the conditions total carbohydrate is reduced. Thus, the stress of deficiency or poor drainage affects the carbohydrate metabolism as severely as N deficiency. S or Fe deficiency does not affect it to any severe extent. In the case N metabolism, all the treatments have equal influence but less intense compared to carbohydrate status.

Yield and oil content: Poor drainage as well as nutrient deficiency tend to reduce the yield of pods quite considerably and the severity concerns the nutrient element (Table II). Poor drainage could reduce the yield by as much as 39.6 per cent, whereas S, Fe and N deficiency reduces the yield by 34.2, 38.5 and 41.0 per cent respectively. Oil content appears very much to be affected due to the stress of poor drainage or nutrient deficiency. Poor drainage has shown a value of 47.7 per cent as against 49.4, 48.3 and 44.2 per cent due to S, Fe and N deficiency respectively. The control has given a value of 50.9 per cent. While little increase is obtained in oil content due to fertilizer application, the reduction is to be expected as the deficiency primarily affects protein synthesis which is linked to biosynthesis of oil.

TABLE II. Effect on yield of dry pods and oil content of groundnut.

Treatments	Yield of dry Pods (g)	Oil Content %
Control	16.45	50.92
— N	9.72	44.20
— S	10.84	49.40
— Fe	10.15	48.33
Poor drainage	9.95	47.67
C. D. (P=0.05)	4.26	

Mean of five replications.

REFERENCES

BENNET, T. P. 1945. *Minor elements. Evidence and concepts on functions, deficiencies and excesses.* Ed. by Firman, E. Bear and Herminie Broedel Kitchen (Baltimore, Md.).

EATON. 1935. Influence of sulphur deficiency on the metabolism of the soybean. *Bot. Gaz.* **97**: 68-100.

GOPALAKRISHNAN, S. and S. S. NAGARAJAN. 1958. Macronutrient deficiency studies on groundnuts. *Ind. Oilseeds J.* **11** : 5–9.

GREGORY, F. G. and E. C. D. BAPTISTE. 1936. Physiological studies in plant nutrition. V. Carbohydrate metabolism in relation to nutrient deficiency and age in leaves of barley. *Ann. Bot.* **50** : 367–402.

JANSSEN, G., R. P. BARTHOLEMEW and V. M. WATTS. 1934. *Ark. Agr. Expt. Sta. Bull.* 310 : 43, pp.

RICHARDS, J. and W. G. TEMPLEMAN. 1936. Physiological studies in plant nutrition. IV. Nitrogen metabolism in relation to nutrient deficiency and age in leaves of barley. *Ann. Bot.* **50** : 367–402.

SIDERIS, C. P. and H. Y. YOUNG. 1944. Effects of iron on chlorophyllous pigments, ascorbic acid, acidity and carbohydrates of *Ananas comosus* (L) Men., *Pl. Physiol.* **19** : 52–75.

STEINBERG, J., J. D. BOWLING and J. F. McMURTREY, Jr. 1956. Accumulation of amino acids as a chemical basis for physiological symptoms in tobacco manifesting frenching and mineral deficiency symptoms. *Pl. Physiol.* **25** : 279–288.