https://doi.org/10.29321/MAJ.10.A02020

Madras Agric J. 76 (1) : 5-9 January, 1989

EFFECT OF SUPPLEMENTAL LIGHT AND REGULATION OF LEAF NUTRITIONAL ENVIRONMENT ON PRODUCTIVITY OF MAIZE AT VARYING INTRA-ROW SPACINGS

A. L. MALI[1] and H. G. SINGH[2]

With the objective of increasing productivity of maize, a field experiment involving two levels of supplemental light (No light and supplemental light), three intra-row spacing levels (15, 20 and 25 cm) and five levels of foliar spray (control, 0.1% H_2SO_4, 0.5% $FeSO_4$, 0.5% $ZnSO_4$ and 0.5% $MnSO_4$), laid out in double split-plot design, was conducted at Udaipur. The results indicated that grain yield, test-weight, chlorophyll content, leaf area index (LAI) and harvest index were significantly increased by artificially provided supplemental light over control (no supplemental light). Intra-row spacing of 25 cm recorded significantly higher grain and total biological yields, test-weight and harvest index than remaining ones. The foliar spray of 0.1 per cent H_2SO_4 gave the highest grain yield followed by sprays of $FeSO_4$, $ZnSO_4$ and $MnSO_4$ and the increases were of the order of 13.3, 9.9, 6.4 and 4.9 per cent over control. Balanced nutritional environment was also obtained due to foliar sprays besides higher LAI, chlorophyll content and yield attributes.

Though Udaipur represents the major maize growing district in the country, the average yields are probably low. The reasons for low yield are (i) lack of light saturation of photosynthetic apparatus as sky remains overcast with clouds for weeks together, (ii) too low or too crowded plant population and (iii) incipient chlorosis resembling those of Fe deficiency in young corn plants grown on alkaline calcareous soils of Udaipur region. Prevention of chlorosis through the application of sulphur appears to increase the physiological availability of iron (Singh, 1970; Gaur, *et al.* 1971). With these considerations in mind, a study was made in Udaipur velley.

MATERIALS AND METHODS

A field experiment was conducted on maize (Ganga-5) in *Kharif* season during 1983 at Agronomy farm, Rajasthan College of Agriculture, Udaipur. The treatments comprising of two levels of light viz., no supplemental light and supplemental light, three levels of intra-row spacing (15,20,25, cm) and five foliar sprays (control, 0.1 H_2SO_4 and 0.5% each of $FeSO_4$, $ZnSO_4$ and $MnSO_4$). assigned to main plot, sub-plot and sub-sub plot, respectively, were tested in double split-plot and replicated thrice. Row to row spacing of 60 cm was kept same in all the spacing treatments. The size of the plot was 6m x 4.2 m. The soil of the experimental plot was clay loam having pH 8.2, organic carbon 0.82%, total nitrogen 0.07%, available P_2O_5 38.0 Kg/ha and available K_2O 162.0 kg/ha. The crop raised as rainfed, was supplied with 80 kg N and 40 kg P_2O_5/ha. All cultural operations were done as and when required, by the crop. Two foliar sprays were applied as per treatment, first spray

1. Asstt. Professor, Deptt. of Agronomy, College of Agriculture, Jobner (Raj.).
2. Director (Research), Agriculture Expt. Station, Sukhadia University, Durgapura, Jaipur.

at tasseling stage and the second at interval of 15 days. The supplemental light was provided for one hour (8.0 P.M. to 9.0 P.M.) at tasseling up to the grain formation stage. The plants in each plot were provided with one tube-light (40 watt) and two electric bulbs (100 watt) to correspond to complete solar spectrum of visible light. A distance of 10 m kept between the plots with light and without light was planted with the same test crop.

Observations on yield and its attributes were taken at harvest. Chlorophyll content at tasseling was determined as per method described by Arnon (1949). Total nitrogen content in oven dried ear leaves and grain was estimated by colorimetric method of Lindner (1944). While phosphorus and potassium contents were analayed by the ammonium vanadate molybdate yellow colour method and flame photometer, respectively (U.S. Salinity Laboratory Staff, 1954). Turbidimetric method (Tabatabai and Bremmer, 1970) was used for estimation of sulphur content.

RESULTS AND DISCUSSION

Effect of supplemental light

Grain and total biological yields were significantly increased due to supplemental light by 20.5 and 6.00 per cent over control respectively (Table 1). The supplemental light had significant effect in increasing chlorophyll, LAI, and test-weight of grain as compared to no light. This treatment, however, did not significantly affect the leaf elemental composition and protein and sulphur contents of the grain (Table 2). Higher yield under supplemental light seems to be on account of cumulative effect of chlorophyll content, LAI, harvest index and test-weight. Increase in chlorophyll content with supplemental light bears and ample testimony to the effect that there was incomplete saturation of photosynthetic apparatus, otherwise light brings about decomposition of chlorophyll. In part beneficial effect of supplemental light may also be due to an increase in the duration of light. Winter *et al.* (1970) also reported increases in grain yields of maize by providing additional incident light.

Effect of intra-row spacing

Out of the 3 spacings, 25 cm spacing recorded significantly higher grain yield, total biological yield, test-weight and harvest index and thus proved to be the best spacing treatment (Table 1). Higher yield under 25 cm spacing could be attributed due to cumulative effect of LAI, total chlorophyll content and test-weight of seeds, which in turn, seems to have been brought about by slightly to significantly increased nitrogen, phosphorus, potassium and sulphur content of the ear leaves (Table 2) which seems to have provided balanced nutritional environment.

Effect of chemical sprays

The grain was significantly increased by H_2SO_4, $FeSO_4$, $ZnSO_4$ and $MnSO_4$ and the increases were of the order of 13.3, 9.9, 6.4 and 4.9 per cent over control (Table 1). Stover yield and total biological yield were also effected significantly. The foliar spray of 0.1 per cent H_2SO_4 gave the highest yield of grain, stover and total biological yield followed by sprays of

Table 1. Effect of supplemental light, intra-row spacing and foliar spray on grain yield and other attributes of maize

Treatment	Total Chloro-phyll (mg/g. leaf)	Leaf sap pH	Leaf area index	Test weight (g)	No. of grains/ Cob.	Length of cob (cm.)	Harvest index (%)	Grain yield (q/ha.)	Stover yield (q/ha)	Total biological yield (q/ha)
Supplemental light										
No supplemental light	2.609	6.21	5.56	175.0	499	14.90	27.0	18.0	48.6	66.3
Supplemental light	3.260	6.21	7.57	181.4	525	16.24	30.7	21.7	48.7	70.4
C. D. at 5%	0 365	N.S.	0.50	3.8	N.S.	N.S.	2.58	2.0	N.S.	1.4
Intra-row spacing (cm)										
15	2.713	6.06	8.05	174.2	500	15.57	26.5	17.6	48.4	66.3
20	3.040	6.20	6.44	178.1	529	15.56	29.0	19.9	48.3	68.3
25	3.052	6.37	5.25	182.3	507	15.58	31.0	21.9	48.5	70.4
C.D. at 5%	N.S.	N.S.	0.62	1.2	N.S.	N.S.	1.9	1.6	N.S.	1.6
Foliar Sprays										
Control	2.378	6.36	5.90	174.1	472	14.75	28.1	18.5	47.2	65.7
H_2SO_4 0.1%	3.098	6.10	7.00	173.8	532	15.76	29.5	21.0	49.4	70.9
$FeSO_4$ 0.5%	3.024	6.18	6.98	180.6	535	16.24	29.3	20.4	49.0	69.3
$ZnSO_4$ 0.5%	3.225	6.18	6.42	178.7	519	15.41	28.7	19.7	48.6	68.3
$MnSO_4$ 0.5%	2.948	6.22	6.52	177.7	502	15.70	28.7	19.4	47.9	67.6
C.D. at 5%	0.398	0.13	0.38	1.5	20	0.62	0.8	0.5	1.2	1.6

Table 2. Effect of supplemental light, intra-row spacing and chemical sprays on select nutrient content in ear leaves (N, P, K, S) and on protein and sulphur content of grain

Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Sulphur (%)	Protein (%)	Sulphur (grain) (%)
Supplemental light						
No supplemental light	2.177	0.2226	2.702	0.1349	15.66	0.1456
Supplemental light	2.216	0.2246	2.795	0.1388	15.69	0.1558
C.D. at 5%	NS	NS	NS	NS	NS	NS
ntra-row spacing (cm)						
15	2.158	0.2228	2.720	0.1346	15.48	0.1477
20	2.164	0.2235	2.703	0.1360	15.68	0.1504
25	2.267	0.2245	2.823	0.1400	15.87	0.1539
C.D. at 5%	NS	NS	NS	NS	NS	0.00465
Foliar sprays						
Control	2.138	0.2191	2.627	0.1214	15.39	0.1311
H_2SO_4 0.1%	2.274	0.2291	2.822	0.1513	16.17	0.1705
$FeSO_4$ 0.5%	2.264	0.2282	2.928	0.1473	16.10	0.1521
$ZnSO_4$ 0.5%	2.181	0.2198	2.738	0.1359	15.46	0.1473
$MnSO_4$ 0.5%	2.123	0.2221	2.727	0.1285	15.25	0.1424
C.D. at 5%	0.113	NS	0.098	0.0158	NS	0.0089

$FeSO_4$, $ZnSO_4$, and $MnSO_4$. Significant increases in grain and total biological yields due to foliar application of different chemicals seem to be due to higher test-weight, number of grains/cob and higher LAI. Higher LAI under foliar sprays seems to have been brought about by a higher total chlorophyll content of leaves and a greater reduction in leaf sap pH (Table 1) resulting due to an increased leaf sulphur content of the plant. Dungarwal *et al.* (1974 b) reported equal or better effect of foliar spray of 0.1% H_2SO_4 on grain yield, chlorophyll content and nutritional environment in corn. They attributed high yield due to H_2SO_4 spray to balanced nutritional environment as evidenced by higher leaf chlorophyll content which is an evidence of activation of iron. Equal or less effect of $FeSO_4$, $ZnSO_4$ and $MnSO_4$ compared with 0.1 per cent H_2SO_4 showed that beneficial effects of former were due to an inadvertant supply of sulphate and/or low pH of these solutions which might have provided favourable nutritional conditions. Equal or better effect of more dilute solution of H_2SO_4 than that of micronutrient solutions further support the above hypothesis.

REFERENCES

ARNON, D. I. 1949. Copper enzyme in isolated chloroplasts polyphenol oxidase in *Beta vulgaris*. *Plant Physiol. 24* : 1-15.

DUNGARWAL, H. S; P. N. MATHUR. and H. G. SINGH, 1974b. Comparative efficacy of foliar sprays of sulphuric acid and sequestrene 138-Fe in corn. (*Zea mays* L.). *Plant and Soil 41* : 207-10.

GAUR, B. L.; H. G. SINGH, and C. A. CAHOON, 1970. Effect of sulphur in the prevention of incipient chlorosis in corn. *Soil Sci. Pl. Analysis* 2 (4) : 259-65.

LINDNER, R. C. 1944. Rapid analytical methods for some more common inorganic constitutents of plant tissues. *Plant Physiol. 19* : 776-86.

SINGH, H. G. 1970. Effect of sulphur in preventing the occurrence of chlorosis in peas. *Agron. J. 62* : 708-11.

TABATABAI, M. A. and J. M. BREMMER, 1970. A Simple turbidimetric method of determining total sulphur in plant material. *Agron. J. 62* : 805-06.

U. S. SALINITY LABORATORY STAFF, 1954. *Diagnosis and improvement of saline-alkali soils*. U. S. D. A. Hand Book No. 60.

WINTER, S. R. and J. W. PENDLETON, 1970. Results of changing light and temperature regimes in a corn field and temperature effects on the apparent photosynthesis of individual leaves. *Agron. J. 62 (2)* : 181-84.