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# CHLOROPHYLL DEVELOPMENT PATTERN OF RICE IN IRON RICH SOILS

Photosynthetic efficiency in crop plants is related to the content of chlorophyll in the leaves. Zelitch (1971) found that photosynthetic rate will increase with chlorophyll content of leaves up to 6 mg $dm^{-2}$. Crop productivity will be regulated by the content as well as the stability of chlorophyll in the entire leaves. This is particularly important in short duration crops. Chlorophyll content is also considered as an index of metabolic efficiency of the plant to utilise the nutrients absorbed. Therefore study of chlorophyll development characteristics in relation to nutrient supply and absorption by the plant will help to give an insight into plant factors that regulate production as well as the efficiency of inputs used. Such an information will help in regulating management practices more judiciously for better crop returns. The results of an experiment conducted with this objective are presented here.

An experiment was conducted at the Agricultural Research Station, Mannuthy of the Kerala Agricultural University using rice variety Jyothi during the kharif season of 1993. The soil was sandy clay loam in texture and acidic in reaction with medium fertility. The experiment was laid out in randomised block design with three replications in plots of 20 $m^2$. The treatments consisted of four levels of nitrogen (0, 35, 70 and 105 kg N $ha^{-1}$). Chlorophyll contents of the leaves collected at 25, 50 and 75 days after sowing and of the boot leaf were analysed (Yoshida *et al.*, 1972). The nutrient contents of the leaf were also analysed (Jackson, 1958). The data were statistically analysed using the analysis of variance technique (Panse and Sukhatme, 1985).

Variation in the levels of fertilizer nitrogen showed difference in the chlorophyll content of the leaf. Though there was no significant variation in the content of chlorophyll components in the leaves at 25 days after sowing (DAS), chlorophyll 'a' significantly varied at 50 DAS and chlorophyll 'b' and total chlorophyll at 75 DAS (Table 1). At 50 DAS highest chlorophyll 'a' content was recorded at application of 70 kg N $ha^{-1}$ and further increase in N showed a tendency to reduce the contents. Though not significant, this tendency was observed in the case of chlorophyll 'b' as well as total chlorophyll at 50 DAS. The N content of the plant during this period of growth had shown an increase with increasing doses of applied N (Table 2). But this increased N content could not bring about a corresponding increase in the chlorophyll content. This points out to the inability of the plant to metabolise and utilise the absorbed N as chlorophyll content is considered to increase linearly with increase in nitrogen content up to 6 per cent (Zelitch, 1971). The upper tolerable limit of Fe content for rice has been reported to be 300 ppm beyond which it will interfere in the metabolism of rice (Yoshida, 1981). Singh (1970) reported that excess iron in plant will limit N utilization and will primarily affect chlorophyll development. In the present study lowest iron content in the plant was above 400 ppm.

The decreasing tendency of the chlorophyll components of the leaves with increasing levels of nitrogen gradually disappeared towards the later stages. The highest content of chlorophyll in the leaves at 75 DAS and in the boot leaf was observed at the highest level of N applied. This suggested a more metabolic utilization of absorbed nitrogen. The increased efficiency of absorbed nitrogen in the biosynthesis of chlorophyll might have been achieved because of a proportionately higher reduction of Fe compared to nitrogen which is the result of application of N against

Table 1. Effect of nitrogen levels on chlorophyll components of leaf at various growth stages of rice, mg $g^{-1}$ fresh weight

| Treat-ment | 25 DAS | | | 50 DAS | | | 70 DAS | | | Of boot leaf | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Chl.a | Chl.b | Total chl | Chl.a | Chl.b | Total chl | Chl.a | Chl.b | Total chl. | Chl.a | Chl.b | Total chl. |
| N (kg ha$^{-1}$) | | | | | | | | | | | | |
| 0 | 0.283 | 1.300 | 3.033 | 1.428 | 1.673 | 3.510 | -0.033 | 1.670 | 1.425 | 0.865 | 1.020 | 1.855 |
| 35 | 1.208 | 1.220 | 2.899 | 1.563 | 1.928 | 3.678 | -0.050 | 2.063 | 1.883 | 0.858 | 1.030 | 1.893 |
| 70 | 1.060 | 1.000 | 2.400 | 1.713 | 2.010 | 4.160 | -0.038 | 2.313 | 2.028 | 1.23 | 1.403 | 2.505 |
| 105 | 1.268 | 1.183 | 2.853 | 1.620 | 1.823 | 3.923 | -0.013 | 2.523 | 2.080 | 1.228 | 1.520 | 2.665 |
| SEm± | 0.170 | 0.209 | 0.438 | 0.090 | 0.183 | 0.248 | 0.18 | 0.274 | 0.213 | 0.086 | | 0.164 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | NS | 0.557 | 0.434 | 0.174 | | 0.334 |

Table 2. Effect of treatments on N and Fe content of rice, %

| Treat-ment | N | | | Fe | | |
|---|---|---|---|---|---|---|
| | 25 DAS | 50 DAS | 75 DAS | 25 DAS | 50 DAS | 75 DAS |
| N (kg ha$^{-1}$) | | | | | | |
| 0 | 1.71 | 1.49 | 1.41 | 0.12 | 0.06 | 0.04 |
| 35 | 2.38 | 2.13 | 1.70 | 0.15 | 0.04 | 0.04 |
| 75 | 2.95 | 2.08 | 1.88 | 0.12 | 0.06 | 0.04 |
| 105 | 3.14 | 2.00 | 1.91 | 0.12 | 0.05 | 0.04 |
| SEm± | 0.19 | 0.18 | 0.13 | 0.02 | 0.01 | 0.01 |
| CD (0.05) | 0.38 | 0.36 | 0.26 | NS | NS | NS |

exclusive native availability of Fe. Another important observation is the absence or the destruction of chlorophyll 'a' and an increase in the content of chlorophyll 'b' compared to the previous observation in the leaves at 75 DAS (Table 1). Chlorophyll 'b' is known to develop from chlorophyll 'a' (Shylk *et al.*, 1963; Bogard, 1966). Absence of chlorophyll 'a' accompanied with a higher chlorophyll 'b' content would suggest total conversion of chlorophyll 'a' to chlorophyll 'b' by 75th day. Jacob (1994) have also reported similar results in rice. Chlorophyll 'a' is considered to be the photosynthetic unit and chlorophyll 'b' the light trapping unit (Conn and Stumpf, 1976). Hence, absence of chlorophyll 'a' in the leaves points out to their incapability to photo-synthesise. Similar defects in chlorophyll stability and biosynthetic process have also been reported by Bridgit and Potty (1992) in rice and Latha (1992) in cashew in iron rich lateritic soils. Yield improvement in rice at constant level of N but with reduction of Fe content has also been reported by Marykutty (1986).

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