PATTERN OF DRY-MATTER ACCUMULATION, AND NITROGEN CONCENTRATION AND UPTAKE AS INFLUENCED BY LEVELS AND METHODS OF NITROGEN APPLICATION IN RAINFED-UPLAND RICE

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Clay loam N accumulation Leaf area index N concentration N nutrition Oryza sativa L. Rainfed upland Sub-tropical Wet season

SUMMARY
Dry-matter accumulation, and concentration and uptake of nitrogen increased with increasing level of nitrogen at all the stages of crop growth. The differences in nitrogen concentration due to nitrogen levels were greatest at panicle initiation stage and started becoming narrower with the advancement in crop age. Split application of nitrogen with its heavier fractions at tillering and panicle initiation stages either through soil alone or soil + foliage ($\frac{1}{4} + \frac{1}{4} + \frac{1}{4}$) resulted in higher dry-matter accumulation, and higher nitrogen concentration and uptake than other methods. The crop, on an average, removed 61 kg N/ha. Plants accumulated nearly 15% of the total absorbed nitrogen, up to tillering, 50% up to panicle initiation and 85–90% up to heading. Proportionately lesser nitrogen uptake and dry-matter accumulation at post-heading stage is an indicative of a major constraint for production efficiency of rainfed-upland rice culture.

INTRODUCTION
Information on the pattern of dry-matter accumulation, and nitrogen concentration and uptake of this nutrient in rice plants is of immense importance with regard to formulation of a nitrogen-fertilization programme matching the nutrient requirement of the crop at different stages of growth. Most of the studies on the dry-matter production1,7,9,12, and nitrogen concentration3,7,10,12 and uptake pattern4,6,7,9,11,12 in rice were conducted under greenhouse or lowland field conditions. Such information with regard to rainfed-upland rice is scarce.

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An experiment was, therefore, undertaken to investigate the effects of varying levels and methods of nitrogen application on dry-matter accumulation, and nitrogen concentration and uptake pattern in direct-seeded rice under rainfed-upland conditions.

MATERIALS AND METHODS

A field experiment was conducted under rainfed-upland conditions at the Crop Research Centre of the Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, India, during the Kharif (wet) season of 1972 and 1973. Pantnagar is situated at 29°N latitude and 79.3°E longitude, at an altitude of 244 m and falls in the sub-humid and sub-tropical climatic zone at the foothills of the Himalayas. The soil of the experimental plot was clay-loam in texture, rich in organic carbon (1.29%), high in available phosphorus (36 kg P/ha), medium in available potassium (187 kg K/ha), and near neutral in reaction (pH 7.3). The cation-exchange capacity of soil was 20 meq/100 g soil.

The experiment was laid out in split plot design with three replications. The combinations of 4 levels of nitrogen (30, 60, 90 and 120 kg/ha) and 2 cultivars ('Padma' and 'Bala') were kept in the whole plots and methods of nitrogen application in subplots (under M1 treatment, whole of nitrogen was applied at sowing through soil. In rest of the treatments, i.e., from M2 to M7, the nitrogen was apportioned at sowing, tillering, and panicle initiation stages as per details given in Table 1). The effects of levels and methods of nitrogen application have been presented and discussed in this paper.

The seeds were drilled in rows 23 cm apart on June 29, 1972 and July 5, 1973 using a seed rate of 60 kg/ha. The crop received a uniform basal application of 26 kg P and 50 kg K/ha in the form of single super-phosphate and muriate of potash, respectively. Urea was the source of nitrogen. The required quantities of urea were sprayed (6.5% maximum concentration) under specific treatments, maintaining the volume of spray at 1000 l/ha. Teepol at the rate of 0.1% was used as wetting agent.

A representative oven-dried (60°C) sample of plant material was analysed for nitrogen content using modified micro-Kjeldahl method and nitrogen was expressed on oven-dry weight basis. The percentage of nitrogen in the whole plant at maturity was derived from a weighted average of nitrogen content in grain and straw. Nitrogen yield was calculated on the basis of dry-matter yield.

RESULTS AND DISCUSSION

Dry-matter accumulation

The rate of dry-matter accumulation was slow up to panicle initiation stage. The peak rate of dry-matter accumulation was recorded around heading and thereafter it again slowed down. Rice plants accumulated nearly three-fourths of their total dry-matter production, up to heading stage.

Effect of N levels

Increasing levels of nitrogen resulted in higher dry-matter production at all stages of growth (Fig. 1). The fact that nitrogen concentration in plants (Fig. 3) and leaf area index (Fig. 2) increased as a result of increased nitrogen application, justifies amply the increased dry-matter production.