ABSTRACT

Efficient use of water and fertilizer nitrogen (N) in cropped fields essentially requires reliable estimates of their field balances. One of the major hurdles to this quantification has been identified in the spatial variability of these two key inputs. Since little is known about the spatial variability of soil water and applied N under rainfed rice and irrigated wheat crops, a controlled field investigation on spatial variability was undertaken on lateritic sandy loam soil during 1985-86 and 1986-87 to characterise spatial variability of soil physical properties, quantify spatial variability of water and N distribution at different crop growth stages as well as to assess spatial variability of growth and yield of crops in response to variability of soil water and fertilizer N.

Spatial variability studies on soil physical properties were conducted on a 10Mx 100 m levelled bare field transect which is divided equally in 50 grids at a lag interval of 2 m. Variability of water and fertilizer nitrogen was studied on cropped field transect of similar dimensions and lag distances. Rice (MW-10) was grown under rainfed condition and wheat (Sonalika HD 104) was irrigated with 6 cm water timed at 1.0 ratio of irrigation water to cummulative pan evaporation. Fertilizer N was applied at the rate of 100 kg N/ha in the form of ammonium sulphate to rice and calcium ammonium nitrate to wheat in two equal splits.

Spatial variability analyses were carried out using classical and geostatistical methods. Under classical statistics mean, standard deviation, coefficient of variation and sample size with 10% allowable error were estimated. Semivariance and autocorrelations were evaluated to understand the spatial structure of the sequences.

The results of the investigation indicated that static soil physical properties, soil water and fertilizer N were normally distributed, while the dynamic water flow properties such as hydraulic conductivity and infiltration rate were

log-normally distributed. Variability of soil water under both rainfed rice and irrigated wheat is generally low. It increases with the advancement of crop growth period and drying of soil. Higher variability of soil moisture at intermediate and deeper depths is allied with high variability in clay and bulk density at these depths, Using spacing of 2 m between adjacent samples a minimum sample size of 3 is necessary to estimate population mean of soil moisture under rainfed rice when variability is low. With medium variability of the sequences the sample size should be increased to 8. Similarly, an average sample size of 3 and 7 is needed for estimating soil moisture under irrigated wheat respectively for sequences having low variability after irrigation and high variability before irrigation.

In correspondence with the variability of soil water and clay content, NH_4^+ -N and NO_3^- -N under both rice and wheat crops are higher at intermediate than surface layer. Variability is low at the beginning and high at the end of fertilizer cycle when the rate of N use by crops is also high. Under rainfed rice the sample requirement for the estimation of NH_4^+-N and NO_3^--N is 5 and 17 respectively at 15 cm depth, while under irrigated wheat it is 14 for NH_4^+-N and 9 for NO_3^--N at the same depth. Sample size is generally higher in second than first fertilizer cycle. The average sampling distance for N estimation under rainfed rice is 14 m in wet soil and 28m in dry soil. Under irrigated wheat the sampling distance for N estimation is 11 m in first year and 22 m in the second year. Spatial variability of growth and yield of crops corresponds generally with the variability of soil moisture and fertilizer nitrogen. A sampling distance of 22 m appears dependable for overcoming spatial variability in recording yields of rice and wheat crops.