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SHORT COMMUNICATION

Quantitative changes in soil microorganisms under rice-based multiple cropping in northern India

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IN A given soil environment, the components of the microbial population are believed to be in equilibrium with one another. Changes in this environment produced by superficial treatments applied over a comparatively short period of time may cause only temporary shifts in this balance (Katznelson and Chase, 1944). But, in the context of large scale adoption of multiple cropping, it is important to evaluate the influence of such intensive cropping patterns involving a number of crops in one year, on the microbial population.

Periodic fluctuations in numbers of bacteria and fungi in the surface soil in a field experiment conducted at the U.P. Agricultural University were studied during 1970–1971. The experiment was begun in 1969–1970, and consisted of five multiple cropping sequences, using recommended agronomic practices (Nair and Singh, 1971), as follows:

1. Rice–wheat–Indian millet (*Panicum miliaceum*),
2. Rice–wheat–green gram (*Phaseolus aureus*),
3. Rice–rape seed (*Brassica compestris* var. *toria*)–wheat,
4. Rice–rape seed–soybean,
5. Rice–potato–wheat.

In all rotations, rice was grown under two soil management systems to compare direct seeding in unpuddled soil with transplanting in puddled soil. The soils were sampled on ten occasions. Samples were collected at random, from 0 to 6 cm depth. The dates of sampling corresponded to the important physiological stages of the crops, such as active vegetative growth, flowering and maturity. Fungal populations were estimated by the soil plate method (Warcup, 1950) using 20 mg air dry soil in peptone dextrose rose bengal agar (Martin, 1950). Bacterial populations were estimated by the dilution plate method using soil extract agar (Allen, 1957) and 10^{-5} and 10^{-6} dilutions, with three replicates per dilution. Colonies were counted after 48 h incubation.

The results are presented in Fig. 1. Weekly averages of maximum and minimum atmospheric temperature and relative humidity during the experimental period are given in Fig. 2.

The total number of bacteria at any time of the year was roughly 10^3 times more than that of fungi under identical conditions, but the fluctuations in both the bacterial and fungal populations were predominantly influenced by climate. However, the increase in population following the onset of hot weather in March was greater under rice–wheat–green gram and

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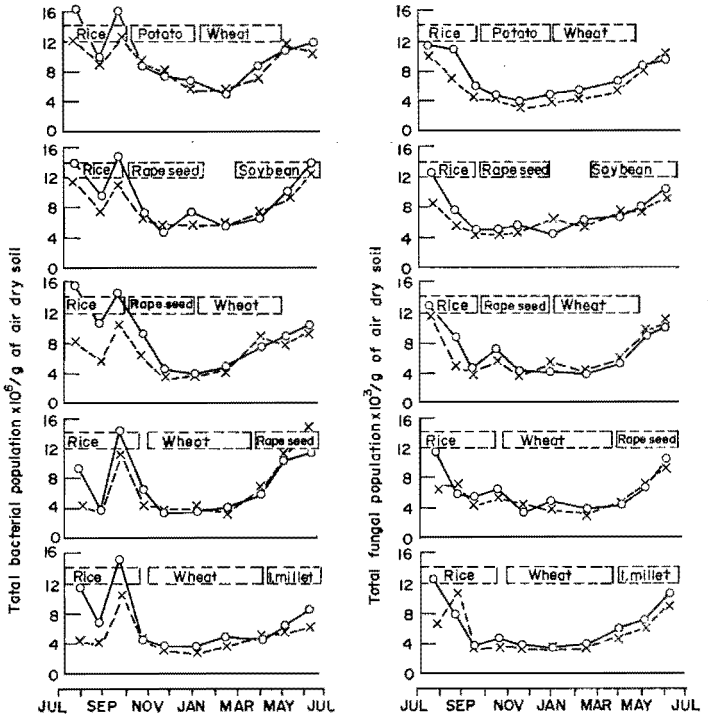

FIG. 1. Periodic changes in total population of bacteria and fungi under different multiple cropping patterns. (○——○) Direct seeding of rice in unpuddled soil. (×– – –×) Transplanting of rice in puddled soil.

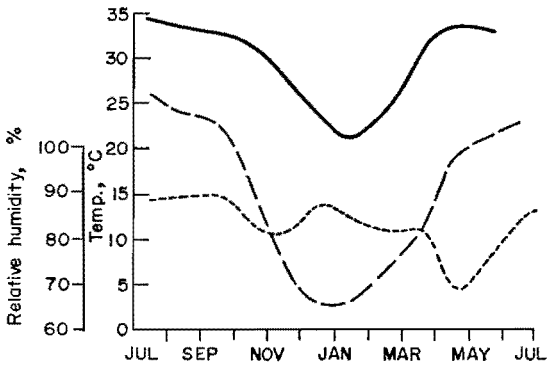

FIG. 2. Changes in maximum and minimum temperature and relative humidity during the experimental period. (——) Maximum temperature (°C). (– – –) Minimum temperature (°C). (· · · ·) Relative humidity (%).

rice–rape seed–soybean rotations, probably because of the influence of the leguminous crops, which are known to provide favourable habitats for microorganisms (Clark, 1949).

Both bacteria and fungi, with two exceptions, were more numerous under unpuddled conditions throughout the growth period of rice, but the differences did not persist after rice had been replaced by other crops in the rotations. Anaerobic conditions and unfavourable

microenvironment caused by puddling of soil might have induced the reduction in populations under puddled conditions.

Variations in the soil environment produced by season, and to a lesser extent by crop variety and soil management system, brought about quantitative changes in microorganisms. But these changes persisted only for the length of time over which the new factors were operative. Cropping patterns, as such, did not influence either the numbers of bacteria and fungi or the equilibrium between them. However, the long-term influence of such intensive cropping and consequent application of heavy doses of agrochemicals, on soil microorganisms remains to be investigated.

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