## Soil-borne and seed-borne pathogens of rice in rice - wheat system-based farmers' fields in Uttar Pradesh

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Pests (insects, weeds, pathogens) are an important component for sustaining rice - wheat systems. Among them, soil- and seed-borne pathogens may play a specific role. Cropping practices may affect the dynamics of these pathogens, both in their survival and epidemic phases. More specifically, the carryover role of other crops in rotation with rice may be critical for these diseases. Pathogen interactions may also alter disease patterns in a field. These interactions remain largely unknown, and we report here some preliminary results on this topic.

Disease incidence due to a few soil- and seed-borne pathogens was quantified in farmers' fields for sheath blight (ShB, *Rhizoctonia solani*), stem rot (SR, *Sclerotium oryzae*), brown spot (BS, *Cochliobolus miyabeanus*), sheath rot (ShR, *Sarocladium oryzae*), panicle blast (PB, *Pyricularia grisea*), crown sheath rot (CShR, *Gaeumannomyces graminis*), and false smut (FS, *Ustilaginoidea virens*). These diseases can be transmitted by seeds (BS, ShR, PB, CShR) or survive as propagules in the soil or in plant debris (ShB, SR, BS, PB, CShR, FS) (Ou 1985). Glume discoloration (GD) symptoms were also considered because they are associated with the presence of different fungi, such as *P. grisea* and *C. miyabeanus*. Eight fields selected to represent a range of crops preceding rice were assessed: two with wheat (B3 and B6), one with rice (B4), one with sorghum (B1), one with maize (PP5), one with lentil (B9), one with fallow (PP2), and one with mint (PP3).

Diseases were assessed at the milk stage. In each field, 20 hills were sampled following a zigzag pattern. For each hill, the total number of tillers; number of tillers infected by ShB, SR, BS, and CShR; total number of panicles; number of panicles infected by ShR, PB, and FS; and number of panicles showing GD were recorded.
Sheath blight, stem rot, brown spot, glume discoloration, and sheath rot were consistently observed in all eight

fields (see table). The other diseases, when present, occurred at low incidences (0-8%) and were not considered for multivariate analyses. The highest incidences were observed for ShB and BS (up to 68% and 85%, respectively), whereas ShR incidence remained below 20% in all fields (see table).

Sheath blight incidence was relatively high in all fields (around 20%) and reached 75% in PP5. Brown spot incidence varied widely between fields, from 8% to 90%. Stem rot was extremely variable too, but within a smaller range of incidence (2-35%). Sheath rot was observed in all fields, but at low incidence. Glume discoloration incidence was around 25% in all fields, except B4 and PP5, which had lower levels (10% and 3%, respectively).

Pearson coefficients of correlation were computed based on disease incidence data collected at the hill level. ShB and SR were negatively correlated (-0.388; $P < 0.001$), and BS was positively correlated with GD (+0.19; $P = 0.013$). Panicle blast was positively, negatively, and negatively correlated with ShB, SR, and GD, respectively, but these correlations should be interpreted cautiously, given the low levels of PB encountered. In a principal component analysis done on disease incidence, the first two axes explained 54% of total variance and the third axis explained 19% (see figure). The first axis mainly reflects a strong opposition between ShB and SR incidences. Axis 2 reflects the association between GD and BS. Axis 3 reflects the opposition between SR and BS.

These preliminary results point to different trends:

- Sheath blight and stem rot appear to be negatively correlated, perhaps because of differences in environments that favor these two diseases or competition between the corresponding propagules, during either the inoculum survival stage or the establishment of the first infections at the base of the rice plant.
- Glume discoloration is correlated with BS. Indeed, *C. miyabeanus is* reported as a fungus associated with GD.
- Sheath rot seems to be negatively associated with BS (see figure); this will have to be further documented.
- Linkages between rotations and disease levels can, cautiously, be hypothesized. For instance, in the case of ShB, PP5 showed an ShB level nearly twice that of other fields. This field was previously planted with maize, which can host *R. solani* AG 1-1A. The effect of the maize-rice system on ShB will have to be further documented.

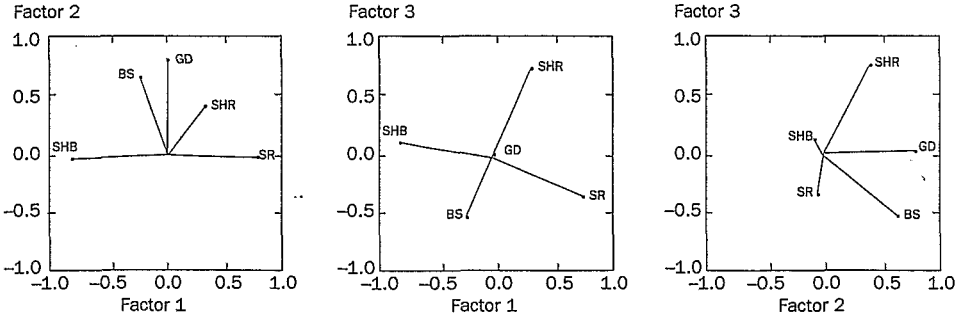
## Reference

Ou SH. 1985. Rice diseases. 2d ed. Kew (England): Commonwealth Mycological Institute. 380 p. ■

**Fraction of infected tillers or panicles in eight farmers' fields under a rice - wheat system, Uttar Pradesh, India.[a]**

| Field | ShB | BS | SR | ShR | CShR | GD | PB | FS |
|---|---|---|---|---|---|---|---|---|
| B1 | 0.18 | 0.7 | 0.18 | 0.09 | 0 | 0.29 | 0 | 0 |
| B3 | 0.16 | 0.45 | 0.25 | 0.09 | 0 | 0.26 | 0 | 0 |
| B4 | 0.22 | 0.37 | 0.15 | 0.04 | 0 | 0.10 | 0 | 0.02 |
| B6 | 0.20 | 0.07 | 0.03 | 0.03 | 0 | 0.25 | 0 | 0.05 |
| B9 | 0.15 | 0.35 | 0.40 | 0.08 | 0 | 0.25 | 0 | 0.01 |
| PP2 | 0.25 | 0.67 | 0.08 | 0.04 | 0.04 | 0.18 | 0.05 | 0.06 |
| PP3 | 0.31 | 0.87 | 0.14 | 0.03 | 0.04 | 0.26 | 0 | 0.01 |
| PP5 | 0.68 | 0.15 | 0.04 | 0.04 | 0.03 | 0.03 | 0.27 | 0.04 |

[a]ShB = sheath blight, BS = brown spot, SR = stem rot, ShR = sheath rot, CShR = crown sheath rot, GD = glume discoloration, PB = panicle blast, FS = false smut.




**Output of principal component analysis on incidence of different diseases in eight farmers' fields.**

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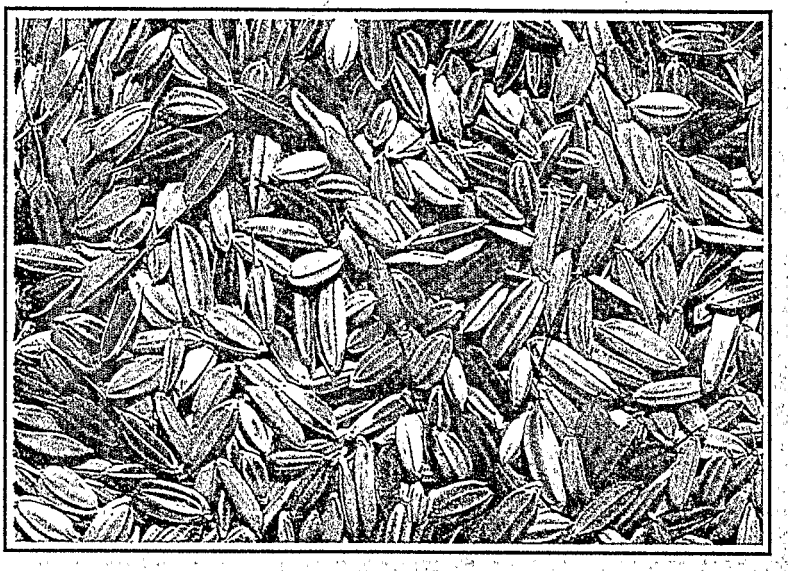

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