A STUDY OF THE EFFECTS OF STORAGE ENVIRONMENTS AND OF RICE WEEVIL *(SITOPHILUS ORYZAE L.)* ON SEED DETERIORATION IN MAIZE *(ZEA MAYS)*

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Rice weevil adult emerging from maize seed.

ABSTRACT

Seed of maize variety XL45 was adjusted to three different initial moisture contents (12.4, 15.1 and 18.5%) and stored under four different environments (20 C - 40% RH, 20 C - 65% RH, 30 C - 40% RH and 30 C - 65% RH) for 20 weeks. Half of the seed samples were inoculated with adult rice weevils (*Sitophilus oryzae*). The remaining seed samples were stored free of insects. Sampling was carried out after 2, 4, 6, 8, 12, 16 and 20 weeks storage. Measurements of seed moisture content, germination, storage fungal development and changes in insect population number and survival were made at each sampling time. Assessments of the number and categories of abnormal seedlings present in laboratory germination tests and internal seed damage caused by insects were also carried out.

The changes in initial seed moisture content in response to the relative humidity level in the storage environment were rapid. All seed samples reached equilibrium moisture contents within the first four weeks of storage irrespective of initial moisture level. Equilibrium moisture content in all cases was below the 15% considered safe for short term storage of maize. In the absence of insects, and in environments involving a 40% level of humidity, no extensive reduction in germination percentage generally occurred. However, a relatively small drop in germination capacity was observed late in the storage period in the most extreme combination (initial moisture content 18.5%, 30 C, 65% RH storage environment, 16-20 weeks storage).

Major deterioration in seed quality occurred only in those storage environments suitable for rice weevil development i.e. 20 C - 65% RH, 30 C - 65% RH. In particular, loss of germination and increase in both the number and categories of abnormal seedlings were apparent in these treatments. X-ray photography of seeds from different storage environments showed the internal damage caused by rice weevils

and this was related to seedling development in sand tests and to normal and abnormal seedling production in standard laboratory germination tests.

Under favourable conditions (20 C - 65% RH and 30 C - 65% RH) rice weevil numbers increased dramatically. This increase was greatest at 30 C and also resulted in an increase in seed moisture content. The other storage conditions (20 C - 40% RH and 30 C - 40% RH) were unfavourable for insect survival. This was a direct effect of the low level of relative humidity which resulted in the death of adult rice weevils and prevented the development of larval populations.

Studies on the rate and extent of internal seed damage using X-ray techniques showed that germination did not deteriorate until larvae had eaten sufficient of the endosperm to prevent adequate food reserves being available for the seedling. The level of damage to seed viability by *Sitophilus oryzae* was clearly a function of the size of the insect population and the time over which it persisted.

The maize seed used in this study was substantially infected by storage fungi initially. However, despite the provision of high temperature (30 C) and a moderate humidity level (65%) for up to 5 months storage fungi did not cause total loss of germinability despite some increase in the levels of *Aspergillus spp.* and *Penicillium spp.* Apparently, even the most extreme environments used in this study were relatively unfavourable for storage fungal development.

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