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MANAGEMENT REPORT
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The prevention of pre-harvest sprouting

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Important Notice

This management report written by the above authors, is being submitted by Dr. Simon Barak in his current capacity of PI for this project, having assumed this position in 2003. This change of management was carried out with the full co-operation and approval of AID. The Israeli PI's during the period of this report were Dr. Moshe Sagi and Prof. Herman Lips and they are thus listed as the authors on the title page.

1) Scientific Summary:

PHS (pre-harvest sprouting) is a major factor in loss of marketing value of wheat grain and diminishes the production of flour. Significant progress has been made on the determination of simple and rapid markers for the estimation of PHS in seeds of new wheat cultivars. The availability of these markers makes possible the rapid and inexpensive screening of PHS-tolerant wheat lines to be used in the cereal fields of Kazakhstan and other Central Asia countries. Once more, the excellent and tight collaboration between Dr. Alikulov and his students and collaborators with the Israeli lab in Sede Boqer has permitted a very effective integration of field and laboratory research which will enable the beginning of larger field tests in the near future.

2) Scientific Issues:

The dedication and initiative of the Kazak researchers, working in close cooperation with the Israeli team and making use of research facilities in Israel, has allowed significant progress in studies to eliminate pre-harvest sprouting in the Kazaki fields through the rapid screening of PHS-tolerant cultivars.

Research achievements

Experiments to determine the activities of Mo-enzymes as early possible markers of the pre-harvest sprouting (PHS) condition (low dormancy) of wheat seeds were carried out in PHS-tolerant (Lutescence 70) and sensitive (Novosibirskaia 67) wheat varieties. The highest activities of aldehyde oxidase (AO) and xanthine dehydrogenase (XDH) were found in the embryos and aleurone layers of the seeds. The activities of these enzymes were significantly higher in PHS-tolerant cultivars than in PHS-sensitive. Wheat embryos, aleurone and endosperm showed no detectable NR activity. NR activity in wheat embryos in the intact seed was detected only after 24 h of incubation in the presence of 0.5 M nitrate. Unlike AO and XDH, the inducible embryonic NR activity in PHS-sensitive cultivars was 2-2.5 times higher than in PHS-tolerant cultivars. Nitrate assimilation may play an as yet uncertain role in PHS in wheat seeds. NR synthesis depended on the content of ABA in the embryo. Embryo ABA content was higher in PHS-tolerant wheat than in PHS-sensitive seeds. **Thus, NR induction in the embryo in the presence of exogenous nitrate may serve as a marker to estimate the PHS-tolerance of wheat seeds.**

A molybdenum cofactor (MoCo) containing protein with a molecular weight of 67-70 kDa was found in dormant wheat seeds. It was shown that this protein has the activity of a fourth plant molybdenum-containing enzyme, sulfite oxidase (SO). The MoCo content of this enzyme was double the usual level observed in other Mo-enzymes of the wheat seed embryo. Apparently its overall content is also higher than that of other Mo-enzymes. Study on the role of SO in seed germination is in progress at the moment.

In developing and maturing wheat seeds, the activity of AO and ABA content reached their maximum at 40-45 days after anthesis, suggesting that AO is involved in the synthesis of ABA. The activity of seed XDH remained at the same stable level throughout seed development. However, no NR activity was detected in the tissue components (endosperm, embryo, aleuron) of developing and maturing wheat seeds. NR was synthesized in the embryo only during seed germination in the presence of nitrate.

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In the another set of experiments, seed priming was carried out by hydration of the seeds for 24 h under different conditions: (1) at 7°C in the dark; (2) at 7°C in sunlight; (3) at 20°C in the dark; (4) at 20°C under light; (5) at 27°C in the dark and (6) at 27°C under sunlight. The seeds lost their capacity to germinate in all treatments that included exposure to light, and presumably the phytochrome system plays an important role during seed priming - a fact that requires further study. The maximum percentage of seed germination and growth rate of seedlings in both PHS-tolerant and sensitive cultivars was obtained when the seed were hydrated at 7°C in the dark while the minimum seed germination was observed when the seeds were imbibed at 27°C in the dark.

Since the activity of the Mo-enzymes depends on the uptake of molybdenum, the seeds were also primed in the presence molybdenum salts such as sodium, potassium and ammonium molybdate. Wheat seeds remained able to germinate at Mo concentrations of up to 70 mM. Mo concentrations above 75 mM started to inhibit seed germination in both PHS-tolerant and sensitive cultivars. During these experiments it was observed that when PHS-tolerant and sensitive were imbibed in the solution of ammonium molybdate, the PHS-tolerant seeds turned blue after 24-30 h, while this phenomenon was very low in PHS-sensitive seeds. Ammonium molybdenum yields a blue color in the presence of antioxidants and phosphate. It is therefore possible that phosphate released by phytase from phytic acid in the embryo and endosperm is involved in the color reaction of PHS-tolerant seeds. Indeed, the total antioxidant content in PHS-tolerant seeds was significantly higher than that in PHS-sensitive seeds. Presently, these experiments are being further studied. **The color reaction of seeds in the presence of ammonium molybdate constitutes a simple and effective a marker to detect PHS-tolerance of seeds of new wheat cultivars produced by breeders.**

3) **Managerial Issues**: None.

4) **Special Concerns:** None.

5) **Collaboration, Travel, Training and Publications:**
Dr. Alikulov and his co-workers are frequent visitors to the Sede Boqer laboratories to make use of facilities not yet available in Astana and the cooperation of Israeli scientists and students in the cooperative research projects. Dr. Alikulov has already three AID/CDR/CAR projects, one accepted and others in preparation. Publications are at the preparation stage and should become available in 2003.

6) **Request for American Embassy Tel Aviv or A.I.D. Actions:** None.