Proposal No. __________

The Anderson Research Grant Program
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Project Title:

Using Varietal Differences in Postharvest Insect Resistance of Northern Great Plains Hard Spring and Winter Wheat Varieties to Increase Profit Potential

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Year 1: $15,850 Year 2: $16,975

ANDERSON RESEARCH FUND - RESEARCH PROPOSAL BUDGET
Problem Identification and Related Research. Hard wheat is grown mainly in northern temperate areas of the world and is considered easy to store due to its resistance to insect attack. Some alarming recent research results now may negate this statement. Recently, the lesser grain borer, *Rhyzopertha dominica* (F.), a southern temperate/tropical insect (see insert) that thrives on hard red wheat has been moving north (Fields and Phillips 1995). *Rhyzopertha dominica* is able to survive Montana conditions, probably due to its ability to locate refugia (microhabitats with the right conditions for survival) in or near the grain mass. The lesser grain borer has been officially found in the postharvest system of Montana since 1987 (Montana Entomology Collection-Bozeman). By 1996, this species had been trapped in commercial grain elevators as well as in on-farm bins in the Helena area, Bozeman, Huntley, Miles city, and the Great Falls area (F. Dunkel, unpublished data). In 1996, however, *R. dominica* was uncommon and not readily recognized by personnel at the grain elevators. In 2001, an informal survey indicated *R. dominica* was readily identified by elevator operator personnel and was ranked by Montana elevator managers as the second most frequently encountered insect in their facility (Watts and Dunkel submitted).

After harvest, varietal suitability for long term storage should be an important consideration of producers when making crop management decisions. If specific wheat varieties are more susceptible to damage from *R. dominica*, then it is important for producers to know this prior to long-term wheat storage. This beetle specifically consumes the endosperm (see insert p. 4), causing a loss of test weight. *Rhyzopertha dominica* infestation in hard wheat causes economic losses through: dry weight loss (Campbell and Sinha 1976; Rao and Wilson 1972; Saxena and Singh 1995), flour deterioration resulting in darker color; reduced loaf volume; poor crumb characteristics; offensive odors (Sanchez-Marinez et al. 1997); and increases in fungal flora, nitrogen, uric acid, and free fatty acids (Charjan et al. 1994).

The most recently published study of Northern Great Plains wheat varietal susceptibility was conducted by McGaughey et al. (1990) with the rice weevil, *Sitophilus oryzae* L., and *R. dominica*. They evaluated grain produced at six or more locations for 5-8 varieties from each of 5 market classes from the crop year 1988. Reproductive rates of both species differed significantly between the 5 classes of wheats. The largest number of progeny occurred on western white wheat, a 21% increase compared to means of other classes. Both species had different reproductive potentials on different classes of wheats. When given free choice, rice weevils selected softer kernels in a sample for oviposition, if range of hardness of kernels was large as in a mixed lot. This correlation was not shown with *R. dominica* whose first instar probably has stronger mandibles and attached musculature than that of *S. oryzae* since the lesser grain borer hatchling must pierce the pericarp and tunnel into the endosperm itself and the mother rice weevil does all this for its first instar offspring. Factors that could contribute to the ability of the young larvae to feed on endosperm of hard wheat are the articular surfaces of the mandible, and specifically the width of the mandible between the hinge line and the point of attachment of the adductor apodeme which would greatly increase the power to the adductor muscle in closing the jaw (Snodgrass 1935). Hence, the stage was set for *R. dominica* to disperse into and dominate in storage environments, such as Montana and North Dakota, where primarily hard wheats were available (Watts and Dunkel submitted).

Other factors besides those tested by McGaughey et al.(1990) may be involved in determining suitability for insect reproduction of individual varieties within a class which would be more important for *R. dominica* than for *S. oryzae*. Alpha-amylase inhibitors in Mexican wheat varieties, for example, were correlated with feeding preferences of *R. dominica* (Cinco et al. 1991). Other studies found no resistance against *R. dominica* in 13 Mexican wheat varieties (Cortex-Rocha et al. 1993), but some resistance against this species was found in Indian varieties (Singh and Singh 1995a,b; Pradham et al. 1972). These studies relied on measuring progeny production. Fifty cultivars of Kansas-grown hard winter wheat were evaluated for their alpha-amylase inhibitory action in *S.*