Susceptibility of Six Wheat Cultivars to Oviposition by Rice Weevils[1] Reared on Wheat, Corn or Sorghum[2]

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ABSTRACT

Seeds of 6 cultivars of wheat, originating in the hard winter wheat area of Kansas, were aged for 3 yr at 60% RH and 26.5°C, and then exposed to parent *Sitophilus oryzae* (L.) from wheat, corn, and sorghum cultures. The susceptibility or resistance to oviposition ratings of the samples of all cultivars to insects from the 3 culture sources (based on progeny production) were very similar. The susceptibility or resistance ratings of the grains also were similar to those obtained prior to the start of the 3 yr aging. The overall effect of either the corn or sorghum culture source of parent adult insects was to reduce the progeny production of the samples of all cultivars below that seen with the parent insects from the wheat culture.

Cross-infestation between stored grains is one way insect populations are initiated or supplemented (Cotton 1963). However, no information is available concerning the influence of the previously stored grains on the rate of oviposition of invading rice weevils, *Sitophilus oryzae* (L.), on wheat, especially wheat that has been stored a long time.

A study was therefore conducted to determine (1) the effects of long-time storage of 6 wheat cultivars on the rate of oviposition of rice weevils reared for several years on wheat, corn or sorghum and (2) any change in the responses of rice weevils reared on wheat to the cultivars after the samples had aged 3 years. The number of emerging adult rice weevil progeny, determined by several workers to be an adequate measure of comparing damage done to grain cultivars (Davey 1965, Stevens and Mills 1973), was used as evidence of the levels of oviposition.

MATERIALS AND METHODS.—Seeds of the 6 cultivars of wheat, all originating in the hard winter wheat area of Kansas, were made available by the Grain Quality and End Use Properties Unit, U.S. Grain Marketing Research Center. All but one cultivar, 'Early Blackhull,' have been released since 1963. The wheats were stored for the 3 yr of the test in insect-free containers held at 26.5°C and 60% RH. When samples were to be tested, kernels were screened over a No. 8 U.S. Standard Sieve and handpicked for uniformity and absence of damage.

The test insects were 14±7 days-old adult rice weevils of the standard Manhattan Laboratory strain that had been maintained as subcultures for several years on wheat, corn or sorghum. They were sieved out of the laboratory containers just before a test.

At the time of test, four 250-kernel samples of each cultivar were prepared and placed in separate vials with screened tops and bottoms. Then 25 active insects were randomly aspirated from an aliquot of the appropriate subculture and placed in each vial. After a 3-day oviposition period, the parent weevils were removed, and the grain returned to the rearing room for progeny development. At 25 days after the parent weevils were removed and at intervals thereafter until emergence ceased, the progeny was removed from the samples and counted.

Two tests were made, one with unaged wheat and rice weevils from the wheat subculture only and one with aged wheat (3 yr) and weevils from each of the 3 subcultures.

RESULTS AND DISCUSSION.—Table 1 shows detailed results. 'Chanute,' 'Parker,' and 'Palo Duro,' which produced the fewest progeny in the test with unaged wheats, performed in essentially the same manner in all tests conducted with aged wheats. Thus, these cultivars were not affected by the aging and by the difference in moisture content. Also, the source of the parent insects made no difference in the number of progeny produced on these 3 aged wheats. In addition, the 3 more susceptible varieties, 'Lancer,' 'Golden Chief,' and 'Early Blackhull,' were still the 3 more susceptible varieties after the 3 yr of aging though there were variations between samples. Production of progeny from aged samples infested with insects from the wheat subculture showed that Chanute and Parker produced significantly fewer insects than the other cultivars. Production of progeny from aged samples infested with parent insects from either the corn or the sorghum subcultures showed that of the two, only Chanute produced significantly fewer insects than other varieties.

Several general observations can be made from the results of the tests. (1) The overall effect of using parent insects from either the corn or sorghum subcultures was to reduce the production of progeny below that of parent insects from the wheat subculture. Parker and Lancer were the 2 exceptions for the sorghum subculture and there were none for the corn subcultures. (2) The egg-laying of the parent insects from the 3 subcultures did not proceed at a constant rate and was affected by the cultivar. For example, in Chanute wheat, the emergence of progeny of parent insects of the corn subculture was slower than the emergence of progeny of parent in-

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[2] Received for publication March 17, 1976.
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Table 1.—Progeny from rice weevils confined on samples of 6 wheat varieties for a 3-day oviposition period in no-choice tests.[a]

Variety	Test with unaged wheat[b]				Test with aged (3 yr) wheat and parent insects from—									
						Wheat subculture			Corn subculture			Sorghum subculture		
	% moisture	x̄ no. progeny	Avg. no.[c] progeny/female	Rank[e]	% moisture	Avg. wt. of 20 randomly selected kernels	x̄ no.[d] progeny	Avg. no.[c] progeny/female	Rank[e]	x̄ no.[d] progeny	Avg. no.[c] progeny/female	Rank[e]	x̄ no.[d] progeny	Avg. no.[c] progeny/female	Rank[e]
Chanute	12.7	15.0	1.20	2	11.7	24.8	13.5 a	1.06	1	8.0 a	0.62	1	11.5 a	0.90	1
Parker	12.9	13.0	1.05	1	11.6	31.8	19.0 a	1.54	2	15.5 b	1.24	2	22.3 b	1.78	2
Palo Duro	12.8	20.7	1.65	3	11.7	22.9	38.3 b	3.06	3	18.5 b	1.48	3	27.5 b	2.20	3
Lancer	13.4	29.2	2.34	4	12.4	28.7	38.8 b	3.16	4	26.5 c	2.12	5	45.5 c	3.64	6
Golden Chief	13.4	51.7	4.14	5	11.5	32.5	52.5 b	4.16	6	34.8 c	2.80	6	33.8 bc	2.70	5
Early Blackhull	13.5	55.5	4.44	6	11.3	34.0	45.3 b	3.82	5	25.0 bc	2.00	4	31.0 b	2.48	4

[a] Four 250-kernel replications/variety with 25 mixed (male and female) weevils/replication. The wheats used in both the initial and aging tests were from the same source.
[b] Parent rice weevils from wheat subculture only.
[c] Based on an assumed 50:50 ratio of males and females.
[d] Means followed by same letter do not differ significantly at the 5% level (Duncan's multiple range test).
[e] In order of no. of progeny produced.

sects of either the wheat or sorghum subcultures. Thus by the end of the 40th day after the start of oviposition, the percentage of completed emergence of progeny of parent insects from the corn, wheat, and sorghum subcultures was 38.7, 62.2, and 73.3, respectively. However, by the end of the 47th day, it was about the same for progeny from all sources. Results were similar with Parker, the other variety producing the least progeny. Palo Duro was more consistent than these two but less consistent than the 3 susceptible cultivars (Lancer, Golden Chief, and Early Blackhull). The patterns of emergence from the 3 susceptible cultivars were very similar for progeny from all 3 sources of parent insects. (3) The weight of the progeny (males and females) produced on the varieties of wheat was essentially the same for parents from all 3 subcultures (Table 2). However, none of the progeny of insects from the corn or sorghum subcultures were as large as the parents. The greater size of the parent insects from the corn subculture compared with those from the wheat and sorghum subcultures may have been a factor in the fewer progeny of rice weevils from this subculture.

No attempt was made to determine the mortality of the rice weevil larvae inside the wheat kernels. Possibly there were internecine activities when 2 or more eggs were placed inside a single kernel. However, x-rays of 100 kernels of each cultivar that had been infested with parent insects from each subculture showed no kernels with multiple larvae when they were examined at intervals during incubation. Also, there was no instance when it could be determined that a larva that had hatched and grown to a size identifiable by x-ray did not continue its development to the adult stage.

Any varietal differences noted here can only relate to the samples of the grains used in these studies.

Table 2.—Average weights of 1st 10 male and 1st 10 female rice weevils emerging from samples of 6 varieties of wheat exposed 3 days to parent adults reared on 3 grains.

Varieties	Weight (mg) of rice weevils developing from seeding adults reared on—					
	Wheat[a]		Corn[b]		Sorghum[c]	
	Males	Females	Males	Females	Males	Females
Chanute	1.53	1.63	1.57	1.76	1.41	1.55
Parker	1.56	1.64	1.63	1.53	1.66	1.70
Palo Duro	1.35	1.51	1.45	1.31	1.50	1.55
Lancer	1.54	1.67	1.62	1.71	1.70	1.80
Golden Chief	1.66	1.44	1.36	1.40	1.30	1.48
Early Blackhull	1.64	1.74	1.73	1.80	1.64	1.72

[a] Male and female parents weighed 1.51 and 1.56 mg, respectively.
[b] Male and female parents weighed 2.27 and 2.34 mg, respectively.
[c] Male and female parents weighed 1.78 and 1.86 mg, respectively.

Additional tests with samples of these varieties grown in different locations and in different crop years would be needed before we could draw any conclusions about varietal differences in susceptibility to weevil oviposition. However, the results do emphasize the difficulty of determining the factors responsible for the levels of progeny production by parent rice weevil females caged in different samples of wheats. Wheat grains are relatively similar and uniform. Corn and sorghum grains differ considerably and may have characteristics that influence the response of the adult rice weevil or the development of the larvae. With grain such as wheat, we cannot easily see such characteristics. Nevertheless, there are differences in the responses of rice weevils to different samples of different varieties of wheats and these differences are reproducible, even after long storage and even when the infesting weevils have been reared on other grains.

REFERENCES CITED

Cotton, R. T. 1963. Pests of Stored Grain and Grain Products. Burgess Publishing Company. Minneapolis, Minn.

Davey, P. 1965. The susceptibility of sorghum to attack by the weevil *Sitophilus oryzae* (L.) Bull. Entomol. Res. 5: 287–98.

Stevens, R. H., and R. B. Mills. 1973. Comparison of techniques for screening sorghum grain varieties for resistance to rice weevil. J. Econ. Entomol. 66: 1222–3.