Rice Mill Fumigation

Effectiveness and user perceptions of ProFume™ in California

Kansas State University (KSU) researchers in spring 2005 initiated a nationwide assessment of flour beetle population dynamics in wheat and rice mills following fumigation, with ProFume™

TABLE 1: Mill 1 Trap Capture Data, 2005

Date	Mean no. beetles/trap/day inside (n=31)	Mean no. beetles/trap/day outside (n=4)
August 5	0.28 (n=22)	3.29 (n=2)
August 5-7	ProFume fumigation	
August 8	Traps replaced	
August 24	0.03 (89.3% Reduction)	3.08
September 8	0.09	3.22
September 21	0.03	0.23
October 5	0.15	0.36

Traps set up on July 22; n=number of traps

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or methyl bromide.

History Prior to 2005

A California rice mill was one of the sites selected for a ProFume™ fumigation starting in 1998. Typically, two fumi-

gations per year are conducted in this mill, one during May over the Memorial Day weekend and one in September over the Labor Day weekend. Since 1998, six fumigations with ProFume were conducted only in May, because the September fumigation was not deemed necessary due to low insect populations.

In a separate mill, four consecutive fumigations were done in 2003 and 2004 under experimental California Research Authorizations. Subsequent to that, ProFume received approval for use in California in May 2005. This mill continues to use ProFume today.

Pest Management

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2005 ProFume Fumigations

In 2005, four ProFume fumigations were conducted in three rice mills.

Mill 1, which has a total fumigated space of 2.71 million cubic feet, was fumigated Aug. 5-7. Mill 2, which has 2.38 million cubic feet, was done May 20-22. Mill 3, which has 420,000 cubic feet of space, was fumigated once May 28-30 and again Sept. 3-5.

> The actual time in which the fumigant was in the plant was less than 24 hours, but 30 to 34 hours was reported because of restrictions on nighttime aeration in California.

All four fumigations were conducted by the same contractor. Mill 1 and 2 had been fumigated 38 to 40 times with methyl bromide by this fumigator over a period of 24 years. Mill 3 cannot be fumigated with methyl bromide because of buffer zone restrictions, and according to the fumigator, none of the mills is "fumigation-friendly," meaning that it is difficult to contain the fumigant for extended periods in these mills.

The average ambient mill temperature in all four fumigations ranged from 80 to 85 degrees, and the total fumigation duration was 30 to 34 hours. The actual time in which the fumigant was in the plant was less than 24 hours. The 30 to 34 hours was of fumigation because of restrictions on nighttime aeration in California.

The estimated average half-loss time across all rooms in mill 1 was 11.3 hours, in mill 2 was 11.0 hours, and in mill 3 was 12.4 hours. The actual observed half-loss time, post-fumigation, was calculated to be 20.4 hours, 11.0 hours, and 15.8 hours, respectively, indicating that the sealing in mills 1 and 3 was excellent resulting in higher half-loss times than what had been estimated.

The estimated average concentration-x-time (ct) product (ounce-hours per 1,000 cubic feet) was 340, 353, and 353 in mills 1, 2, and 3, respectively. The actual observed ct product in mill 1 was 350, in mill 2 was 428, and in mill 3 was 414 ounce-hours per 1,000 cubic feet. The use of precision fumigation principles resulted in the close agreement between the expected and observed ct products.

Gauging ProFume Effectiveness

The effectiveness of ProFume ▶

TABLE 2: Mill 2 Trap Capture Data, 2005

Date	Mean no. beetles/trap/day inside (n=30)	Mean no. beetles/trap/day outside (n=5)
May 20	0.14	0.77
May 20-22	ProFume fumigation	
May 24	Traps replaced	
June 15	0.03 (78.6% Reduction)	1.63
June 29	0.03	0.21
July19	0.03	1.79
August 2	0.15	1.20
August 24	0.27	1.74
September 8	0.49	4.11
September 21	0.11	1.53
October 5	0.47	2.35

Traps set up on May 5; n=number of traps

TABLE 3: Mill 3 Trap Capture Data, 2005

Date	Mean no. beetles/trap/day inside (n=30)	Mean no. beetles/trap/day outside (n=5)
May 28	0.13 (n=19)	No traps outside
May 28-30	1st ProFume fumigation	
May 30	Traps replaced	Traps placed outside
June 15	0.01 (92.3% Reduction)	0.10
June 29	0.01	0.21
July19	0.06	1.79
August 2	0.17	1.20
August 24	0.14	1.74
September 2	0.58	4.11
September 3-5	2nd ProFume fumigation	
September 8	Traps replaced	
September 21	0.04 (93% Reduction)	
October 12	0.68	2.67

Traps set up on May 12; n=number of traps

fumigation on insect populations was assessed by placing 19 to 35 traps in various locations of each mill. About two to five traps were placed outdoors to assess outside populations.

Food-baited traps fitted with pheromone lures to capture red and confused flour beetles were used. Traps were retrived every two weeks. Traps and lures were replaced on each sampling occasion.

The adult flour beetles in traps, predominantly red flour beetles, are expressed in **Tables 1, 2,** and **3** as number of adults captured per trap per day.

At each of the mills, the average insect capture of red flour beetles outdoors was higher than captures recorded indoors, as shown in the three tables. Each of the mills had insect captures prior to ProFume fumigation, and the percent reduction in captures immediately after fumigation ranged from 79% to 93%.

In mill 1, captures two months after fumigation were lower than captures prior to fumigation. In mills 2 and 3, it took two months for trap captures after fumigation to reach levels similar to pretreatment levels. In mill 3, the posttreatment captures were similar to pretreatment caputres after one month.

These results based on trap captures should be interpreted

with caution, as trap captures are affected by several factors including temperature, degree of sanitation, effectiveness of exclusion practices, and degree of suppression obtained within the mill.

However, the use of traps is easy, and traps provide one measure of fumigation success.

It is extremely important to correlate trap caputures with other mill environmental information to understand reasons for population rebounds.

Following proper sanitation and exclusion practices in mills is essential to extend the degree and durationof insect suppression obtained with ProFume fumigation, or for that matter, with any pest management intervention.

Performance Perceptions

The rice millers and the fumigator were surveyed using questionnaires as well as by telephone interviews.

Millers were surveyed with a questionnaire to determine their perception of the fumigation "effectiveness." The effectiveness rating by the millers was based on bioassays, trapping data (mills 1 and 2), and visual observations (mill 3).

Following proper sanitation and exclusion practices in mills is essential to extend the degree and duration of insect suppression obtained with ProFume fumigation, or for that matter, with any pest management intervention.

The millers gave ProFume performance a rating of 5 (excellent) on a scale of 1 to 5 based on "no infestation after 30 days or longer," and all of the millers indicated that they would continue to use ProFume fumigation in the future.

The fumigator also rated ProFume as 5 in 17 out of 18 categories that dealt with sealing, gas introduction, dispersion, monitoring, aeration, and costs.

The fumigator indicated that mill 3 was fumigated six times in three years with ProFume to the miller's satisfaction. In other words, the miller did not have any complaints, and this miller had requested that other structures be treated with ProFume.

The fumigator indicated that the cost of ProFume fumigation was similar to that of methyl bromide. However, the material costs and labor were reported to be slightly higher when using ProFume because of the additional sealing required. This additional sealing was a result of the need to estimate half-loss times in various locations of the fumigated mill.

Furthermore, these material and labor costs were offset by the length of time required for gas equilibration within the mill and the quick aeration time. The fumigator reported that, overall, there was no downtime difference between methyl bromide and ProFume.

The fumigator also reported that the use of precision fumigation principles made him a better fumigator and provided the flexibility to conduct effective fumigations under a variety of circumstances.

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