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Application of Phosphine (pH_3) Fumigation in Wheat Milling Silos Storage

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Abstract

Wheat is considered as one of the main cereal crops in the world as well as in Egypt. The importance of wheat as a major food source for human in many countries. In Egypt the total general consumption of wheat is about 14.2 million ton of which: 42% about (5.96 million ton) is made baladi bread. 33% about (4.69 million ton) is made home bread in the villages and 25% about (3.55 million ton) is milled into wheat flour 72% extraction to satisfy the needs of citizens from this flour. The total cultivated area with wheat in Egypt was about 3.00 million feddan produced 8.00 million tons of wheat in 2011 season, while the imported foreign wheat around 6.20 million tons. This indicates that the total imported wheat represented about 50% of the general local consumption.

The results could be summarized as follows:

Grains of both varieties could be fumigated with phosphine pH_3 after 24 hours exposure period and after 3 months storage period led to germination percentage within all genotypes. Results were cleared that Giza 168 variety gave the highest value as compared with other varieties, while Ukrania variety gave the lowest one.

Introduction

Good seeds are important and necessary to obtain satisfactory yields and essential as human food. The main factors affecting the quality of seed are the methods of production, handling and storage. The deterioration occur during grain storage has been a subject of interest for many years. The role of insects in bringing about spoilage of grains should be considered. As a matter of fact every store used for large quantities of seed is sure to be treated for pest infestation. Fumigation is considered one of the most suitable means for insect control and seed preservation (Monro, 1969).

Wheat is the most important major cereal crop in the world as it is a stable food for more than one third of the world population (El-Marakby *et al.*, 2002). It is the most abundant cereal all over the world and is one of the least expensive cereals available for creating fabricated foods of higher nutritional value.

Bread making is one of the oldest food industries, possibly the first industry to be practiced outside the home. The development of bread making has been

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initiated with the history of civilization itself (Atia, 1989). In Egypt, as in the case of most developing countries, bread is considered the major item in providing the caloric intake. It is estimated that bread supplies about 50-90% of the total energy depending on the individual income (Hugo *et al.*, 2000). Wheat is the main cereal crop cultivated in Egypt, however, its production is not sufficient to cover the needs of the population. Therefore, large quantities of wheat are imported from other countries (Faridi and Rubenthaler, 1983). Baladi bread, a widely consumed flat bread, is the most popular bread produced in Egypt and other countries in the Middle East. Baladi bread is the Egyptian type of Arabic bread which is the main staple in the Middle Eastern diet. It is vitally important to millions of low income individuals. Its production is subsidized by the Egyptian government which allocate a high amount of the budget to secure the citizens needs of cheap bread (Atia, 1989). In 2009, the total consumption of wheat in Egypt was about 14.2 million tons of which 42% (about 5.96 million tons) is manufactured to baladi bread while 33% (about 4.69 million tons) is used for home bread in the villages. In addition, 25% (about 3.55 million ton) is milled into wheat flour (72% extraction) to satisfy the needs of citizens from this flour. The total cultivated area with wheat in Egypt was about 3.0 million feddan produced 8.0 million tons of wheat in 2011. So, the imported amount of wheat was around 6.2 million tons. This indicates that the total imported wheat represented about 50% of the general local consumption at that year (Annual Report of Ministry of Agriculture, 2010).

The aim of the present study was to determine the effects of storage and fumigation of local and imported wheat for quality parameters of bread making.

Materials and Methods

This experiment was conducted at the Laboratories of the Agronomy Department, Faculty of Agriculture, Assiut University, during the period June 2008 – May 2009 and the Laboratories of Upper Egypt mills Company Sohage (Tahta mill – Mena mill – Tema mill). Grains of wheat varieties were tested for viability and quality parameters. Five introduced wheat batches including three imports from Russia, French and Ukrania along with two local varieties (Giza- 168 and Sids-1) were fumigated with PH_3 and stored for periods of 3, 6, 9 and 12 months as follows.

Preparation and conditioning of the grains:

The genetic material of the present study consists of five batches from different sources. Grains were sieved and cleaned from dust, hask or any inert material. The moisture content of the grains were determined by the air draft oven method according to A.O.A.C. (1995).

A – Fumigation of grains:

A.1- Assessment of doses:

Phosphine, (PH_3) is a fumigant where the gas is slowly evolved from tablets containing aluminium phosphide. The required dose of the fumigant was attained by crushing a tablet (3 g), then the necessarily weight was obtained using a small wire loop standardized for this purpose.

A.2- Fumigation technique:

Phosphine was applied at the dosages of 3 tablets/ton of grains for four days. Placed for the intended exposure period. After fumigation, grains were aerated for fourty eight hours. As follows: 20 kg of each wheat batches were kept unfumigated as start control in open storage and used 200 kg from each wheat batches were fumigated with phosphine PH_3. five exposure periods were used; i.e. after 24 h, 48 h, 72 h, 96 h, 120 h. These batches were stored for 3, 6, 9, 12 months in Jars per batch. Storage of five batches started on period June 2008 – May 2009. after the completion of exposure period, each group was placed in bags similar to the untreated batches and kept in open storage.

B – Post fumigation storage:

Batches of grain were tested directly after fumigation for the characters studied while other samples were stored in the laboratory in the air-tight fumigation jars for 0 to 12 months, after which they were examined for quality. Storage of five batches started on June 2008 – May 2009.

C – Grain viability:

Germination tests were performed in accordance with the techniques specified by the International Seed Testing Association, (I.S.T.A., 1993). Grains were disinfected by 0.2% solution of mercuric chloride for two minutes, then washed under running tap water for one hour. Wheat batches were evaluated with four replications. Each replicate of 100 grains were set to germinate on ashless filter paper in 9 cm Petri-dishes containing 25 grains each, each dish was watered with 6 ml of distilled water followed by 4 ml after three days. Grains were incubated at 20 ± 1°C for 10 days. Grain viability was expressed as Germination percentage (number of grains germinated after 7 days) Waller, R.A. and D.B. Duncan (1969).

Results and Discussion

1- Germination percentage after 3 months storage:

Grain batches germination percentages were at maximum 100%. All batches revealed that the fumigation treatments the grains and storage period and exposure period significantly affected the germination percentage of the five tested wheat varieties.

Results in Table 1 revealed that, mean of germination percentage ranged from (86.75) to (87.65%) for exposure period and (69.50) to (94.54%) for batches. Increasing exposure period led to decrease germination percentage within all batches. The maxi-

mum value of germination percentage were (94.54%) also, the minimum depression occurred in germination percentage from without phosphine to exposure period 120 hours (1.00%) were obtained from batches variety 1. This mean that, batches variety 1 was more tolerant and adapted to long time exposure period without a big deterioration when compared with other batches under study.

On the other hand, the minimum germination percentage (69.50%) and the highest depression in germination percentage (25.04%) were recorded for batches variety 5. Decreasing germination percentage may be due mainly to hose factors, which could affect grain density.

The obtained results were in harmony with which obtained by Adugna Haile (2006), Hakansson Wennermark Jag & Rstad (2006), Kychan *et al.* (2008) and Reny *et al.* (2008).

2- Germination percentage after 6 months storage:

Results in Table 1 revealed that, mean of germination percentage ranged from (84.90) to (86.40%) for exposure period and (67.71) to (92.83%) for batches. Increasing exposure period led to decrease germination percentage within all batches. The maximum value of germination percentage were (92.83%) also, the minimum depression occurred in germination percentage from without phosphine to exposure period 120 hours (1.50%) were obtained from batches variety 1. This mean that, batche variety 1 was more tolerant and adapted to long time exposure period without a big deterioration in compared with other batches under study.

On the other hand, the minimum germination percentage (67.71%) and the highest depression in germination percentage (25.12%) were recorded for batche variety 5. Decreasing germination percentage may be due mainly to hose factors which could affect grain density.

Table 1.Effect of exposure periods five batches wheat after fumigation with PH_3 and their interaction on germination percentage after 3 and 6 months storage.

Exposure period (P)	Varieties (V)					
	Giza 168	Sids 1	Russia	French	Ukrania	Mean
3 months						
Without phosphine	95.00	94.00	89.50	90.25	70.00	87.65
24 h	94.75	93.75	89.25	90.00	69.75	87.50
48 h	94.75	93.50	89.25	90.00	69.50	87.40
72 h	94.50	93.50	89.00	89.75	69.50	87.25
96 h	94.25	93.25	88.75	89.50	69.25	87.20
120 h	94.00	93.00	88.50	89.25	69.00	86.75
Mean	94.54	93.50	89.12	89.87	69.50	
6 months						
Without phosphine	93.50	92.75	88.25	89.00	68.50	86.40
24 h	93.25	92.50	87.75	88.75	68.25	86.10
48 h	93.00	92.00	87.50	88.50	67.75	85.75
72 h	92.75	91.75	87.25	88.25	67.50	85.50
96 h	92.50	91.50	87.00	88.00	67.25	85.25
120 h	92.00	91.00	86.75	87.75	67.00	84.90
Mean	92.83	91.91	87.42	88.38	67.71	

LSD 5%	**3 months**		6 months	
Varieties (V)	=	0.348	0.27	
Period (P)	=	0.382	0.29	
V x P	=	0.854	0.65	

The obtained results were in harmony with which obtained by Fam *et al*,. (1975), Kamel *et al.* (1975), Khalaf (1978), Desmarchelier and Chaly (1993), Garduer *et al.* (1996), Mamuya *et al.* (2001), Stehno (2002), Steven *et al.* (2002), Yong-Liu Ren *et al.* (2002), Calucci *et al.* (2004), Prasad and Rao (2005), Adugna Haile (2006), (Hakansson) Wennermark Jag & Rstad (2006), Kychan *et al.* (2008) and Reny *et al.* (2008).

3- Germination percentage after 9 months storage:

Results in Table 2 revealed that, mean of germination percentage ranged from (82.75) to (84.00%) for exposure period and (65.38) to (90.37%) for batches. Increasing exposure period led to decrease germination percentage within all batches. The maximum value of germination percentage were (90.37%) also, the minimum depression occurred in germination percentage from without phosphine to exposure period 120 hours (1.25%) were obtained from batches variety 1. This mean that, batches variety 1 was more tolerant and adapted to

long time exposure period without a big deterioration when compared with other batches under study.

On the other hand, the minimum germination percentage (65.38%) and the highest depression in germination percentage (25.09%) were recorded for batches variety 5. Decreasing germination percentage by storage seeds. The results indicated that the magnitude of difference between varieties.

The obtained results were in harmony with which obtained by Garduer *et al.* (1996), Mamuya *et al.* (2001), Stehno (2002), Steven *et al.* (2002), Yong-Liu Ren *et al.* (2002), Calucci *et al.* (2004), Prasad and Rao (2005) Reny *et al.* (2008).

4- Germination percentage after 12 months storage:

Results in Table 2 revealed that, mean of germination percentage ranged from (79.95) to (81.60%) for exposure period and (62.75) to (88.04%) for batches. Increasing exposure period led to decrease germination percentage within all batches. The maximum value of germination percentage were

Table 2.Effect of exposure periods five batches wheat after fumigation with PH_3 and their interaction on germination percentage after 9 and 12 months storage.

Exposure period (P)	Varieties (V)					
	Giza 168	Sids 1	Russia	French	Ukrania	Mean
9 months						
Without phosphine	91.00	90.00	86.00	87.00	66.00	84.00
24 h	90.75	89.75	85.75	86.75	65.75	83.75
48 h	90.50	89.50	85.50	86.50	65.50	83.50
72 h	90.25	89.25	85.25	86.25	65.25	83.25
96 h	90.00	89.00	85.00	86.00	65.00	83.00
120 h	89.75	88.75	84.75	85.75	64.75	82.75
Mean	90.37	89.38	85.38	86.38	65.38	
12 months						
Without phosphine	88.75	87.50	83.25	84.75	63.75	81.60
24 h	88.50	87.25	83.00	84.50	63.25	81.30
48 h	88.25	87.00	82.75	84.25	62.75	81.00
72 h	88.00	86.75	82.50	84.00	62.50	80.75
96 h	87.75	86.50	82.25	83.75	62.25	80.50
120 h	87.00	86.00	81.50	83.25	62.00	79.95
Mean	88.04	86.83	82.54	84.08	62.75	

LSD 5%		**9 months**		**12 months**	
Varieties (V)	=	0.28		0.265	
Period (P)	=	0.30		0.291	
V x P	=	0.66		0.650	

(88.04%) also, the minimum depression occurred in germination percentage from without phosphine to exposure period 120 hours (1.65%) were obtained from batches variety 1. This mean that, batches variety 1 was more tolerant and adapted to long time exposure period without a big deterioration in compared with other batches under study.

On the other hand, the minimum germination percentage (62.75%) and the highest depression in germination percentage (25.29%) were recorded for batches variety 5. Decreasing germination percentage by storage seeds. These results indicated that the magnitude of difference between varieties.

The obtained results were in harmony with which obtained by Fam *et al*,. (1975), Kamel *et al.* (1975), Khalaf (1978), Desmarchelier and Chaly (1993), Garduer *et al.* (1996), Mamuya *et al.* (2001), Stehno (2002), Steven *et al.* (2002), Yong-Liu Ren *et al.* (2002), Calucci *et al.* (2004), Prasad and Rao (2005), Adugna Haile (2006), (Hakansson) Wennermark Jag & Rstad (2006), Kychan *et al.* (2008) and Reny *et al.* (2008).

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استخدام التبخير بالفوسفين في صوامع التخزين لمطاحن القمح

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أجريت هذه التجربة في معامل قسم المحاصيل – كلية الزراعة – جامعة أسيوط ومعامل شركة مطاحن مصر العليا (المعمل المركزي بمطحن مينا بسوهاج ، معمل طهطا ، معمل طما) خلال يونيو 2008 حتي مايو 2009 لدراسة مدي حساسية بعض أصناف القمح المحلية والمستوردة للتدخين بالفوسفين واستخدم 5 أصناف منهم أثنان محلي وثلاثة مستوردة وكان هناك 5 فترات تعريض بعد 24 ساعة ، 48 ساعة ، 72 ساعة ، 96 ساعة ، 120 ساعة، وفترات التخزين صفر ، 3 ، 6 ، 9 ، 12 شهر وتم عمل بعض اختبارات الحيوية وهي سرعة ونسبة الإنبات.

وجد أنه مع زيادة فترة التخزين والتبخير بالفوسفين كان له تأثير معنوي واضح علي نسبة وسرعة الإنبات لحبوب القمح ولقد وجد أن أفضل نسبة وسرعة عندما تعرضت لفترات التخزين لمدة 3 شهور وفترة التعريض بالفوسفين بعد 24 ساعة وكان أفضل الأصناف في نسبة وسرعة الإنبات هو جيزه 168 بينما أقلها هو المستورد الأوكراني.