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EFFECT OF SOME SEED TREATMENTS BEFORE STORAGE ON WHEAT SEED QUALITY.

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ABSTRACT

This investigation was conducted under the laboratory conditions of Seed Technology Research Unit, Mansoura, Dakahlia Governorate, (ARC) during 2011 year to study the effect of seed moisture content (11, 14 and 17%) and seed treatments (Fungicide, plant material and fumigation) on wheat (C. V. Sakha 93) seed quality after six months from storage. The experiments were arranged in a Completely Randomized Design with four replicates. The main results could be summarized as follows:-

Increasing wheat seed moisture content before storage more than 14% significantly decreased standard germination and increased fungi infestation percentage. After storage with six months, standard germination also decreased specially wheat seed had 17% moisture content meanwhile, storage pests (insect infestation and fungi infestation) and seed dry weight loss percentage were increased.

Significant differences among wheat seed treatments on insect infestation percentage, seed dry weight loss and fungi infestation percentage were detected. Treated seed with recommended dose (3 tablets /m^3 PH_3) under low levels of relative humidity 37% and 57% for 3 days was effective in maintains wheat seed quality fore six months. The interaction among seed moisture content and seed treatments had a significant effect on all studied traits.

From the former results, wheat seed c.v. (Sakha 93) could be store in open air with maintain good quality seed at moisture content not exceeded 14% after treatment with (fungicide + fumigation with PH_3 at relative humidity up to 57%) or (neem oil + fumigation with PH_3 at relative humidity up to 57%).

INTRODUCTION

Wheat *Triticum aestivum,L.,* is the most important world's leading cereals crop. In Egypt, wheat is considered the strategic crop while, it is the main source of human food. The over expanding of increasing population in Egypt have emphasized the importance of increasing the productivity of wheat per unit area of land since the area devoted for wheat production is limited. In the winter season of 2011/2012, the cultivated area of wheat reached about (2.7 million feddan) produced an average of 8.796 million ton of grains (FAO STAT, 2012). So it is very essential to increase wheat productivity, this can be achieve through planting high quality seed but in Egypt, yielded wheat grains during harvest and storage faces adverse environment conditions as increasing relative humidity, temperature degrees, as well as storage pests (insects and fungi) where high losses due to storage pests in quantity and quality are taken place in stored wheat seed especially at high moisture levels. Chattha *et al*. (2012) decided that wheat seed stored with initial moisture content of 10% showed germination capacity throughout

the storage period than those with 16% moisture. Also, Malaker *et al*. (2008) found that of high moisture content, increased and seed germination decreased with the increase of storage period. Various fungal floras associated with wheat seeds differed in their prevalence depending on the length of storage period. The population of field fungi decreased while that of storage fungi increased with the progress of storage period. On the other side, Mersal *et al*. (2006) revealed that prolonging storage period and high seed moisture content reduced germinability and seedling vigour of wheat seeds. Meanwhile, mean germination time, insect infestation and dry weight losses of the seed were increased. Also, Badawi *et al*. (2009) found that Prolonging the storage periods from 0 to 6 months from storage lead to the decrease in germination percentage, seed and seedling vigor traits. While this increase in storage period lead to the increase in mean germination time and insect infestation percentage. So, wheat seed treatments by insecticides, plant extracts or fumigants for protection or management storage pests are becoming more important and common among agricultural procedures. Several investigators recommended the importance of using chemical insecticides to control the pests of stored grains, Rufino *et al.* (2013) concluded that wheat seeds treated with zinc, fungicide and polymer are positively influenced until 30 days after emergence. The germination of wheat seeds is positively influenced by the treatment with fungicide. Also considerable efforts have been focused on plant derived materials, potentially useful as commercial insecticides. The harmful effects of plant extracts on insects can be manifested in numerous manners including toxicity, repellent effect, can work as phages restrainer and can affect the insects hormonal system (Hill,1990). While, Kumawat and Bhanwar 2013, found that the maximum protection was provided by neem oil and no grain damage was recorded. On the other side, although fumigation is one of the most effective method to control the storage insects, but it is effective only when seeds are fumigated with desired fumigant at desired quantity at normal temperature and moisture content with minimum exposure period. Among different fumigants, *aluminium phosphide* is considered as one of the safest fumigant as it is not having deleterious effect on seed quality. Lorini. *et al.* (2011) concluded that the release of gas in phosphinyl starts soon after the availability of the tablets on the environment, increasing the concentration over time until complete dissolution of the tablet steaming.

The most important targets of the present study were: To evaluate the insecticides, fungicide and plant products for their efficancy as seed protectants against stored pest (insect and fungi) during short storage. Improving seed quality through using the most promising storage periods and Increase seed quality for maximum yielding ability.

MATERIALS AND METHODS

Laboratory experiments were conducted at the laboratory of Seed Technology Research Unit, El-Mansoura, Dakahlia Governorate, ARC, to study the effect of seed moisture content (11, 14 and 17%) and seed

treatments (Fungicide, plant material and fumigation) on wheat seed (C. V. Sakha 93) seed quality deterioration after six months from storage. Each experiment included 36 treatments which were the combination of three seed moisture content (11, 14 and 17%) and twelve seed treatments which were (un treated, fungicide, neem oil, fumi at 37% RH, fumi at 57% R.H, fumi at 77% R.H, fungicide + fumi at 37% RH, fungicide + fumi at 57% R.H, fungicide + fumi at 77% R.H, neem oil + fumi at 37% RH, neem oil + fumi at 57% R.H and neem oil + fumi at 77% R.H). The experiments were arranged in a Completely Randomized Design with four replicates.

The studied factors were:-

1- Seed moisture content. The studied seed moisture levels were 11%, 14% and 17%. Wheat seed was obtained from Wheat Section, Field Crops Research Institute, Agricultural Research Center and seed moisture content was determined by electrical air-oven method owing to **A. O. A. C. (1955**) and it was (14±0.2%). To obtain 11% moisture level, wheat seed was dried in speed dry air apparatus Model Retsch (F-Kurt Retsch Gonb H and Co. K G D.42781 HAAN Germany) until obtaining moisture level (11±0.2%). Seed moisture level was adjusted to 17% by using the technique of **El-Rafie (1958)** according to the following formula:

$$M = \frac{B - A}{100 - B} \times K$$

Where: A → the initial moisture of seed. B → final request moisture content. M → the quantity of distilled water to be added. K → the quantity of seed to be conditioned. Keeping in consideration to conditioned sampled which contained more than 14% moisture content were kept for fumigation more than 3 weeks after it had been humidified recommended by **Swanson (1941).**

2- Seed treatments:- Each seed moisture level was treated with the following treatments:

1.Fungicide: Wheat seeds were treated with fungicide Maxim XL 3.5% FS (1.0 cm^3/kg).

2.Nimbecidine (Azadirachtin 0.05% EC): wheat Seed treated with Nimbecidine {Azadirachtin (neem bitter) 3.5% and neem oil 75.5%} as source of neem oil, was obtained from local market.

3.Fumigation (fumi): Phosphine or Hydrogen phosphide (PH_3) fumigation using the recommended dose (3 tablets/m^3) under three levels of relative humidity (37%, 57% and 77%).

A- Fumigation technique:-

Fumigation was carried out in wide mouth glass jars and covered with springe cover lind with rubber-ring. The capacity of each jar was 2.0 L. the weight of each sample for wheat seed was 1.2 Kg. The required doses of phosphine (3 tablets/m^3) were attained by crushing a tablet (3.0 g) and then the necessary weight was obtained. Seed was placed into the jars, and then a piece of cotton was placed above the seed to remove the residual powder after fumigation, glass 100ml. containing the required concentration of H_2SO_4 was placed in the jar to get the studied relative humidity , After that the cover was placed. After fumigation for 3 days, seed were aerated for 72 hr.

B- The relative humidity (R.H) during fumigation: The required relative humidity's(37%, 57% and 77%) were obtained by using different concentrations of H_2SO_4.

The studied traits:

1. Germination percentage: It measured according to the method outlined in the rules of seed testing **(ISTA, 1999)** and defined as the total number of normal seedlings after 8 days.

2. Insect infestation percentage: After 6 months storage period, four replicates 100 seed from each sample were manually picked from each cloth bag from different depth for inspection. seeds which having holes or infestation were collected also, the grain which showed sings of insect damage were considered as infested. The infestation level was expressed as percent damage grains according to this formula, **Jood *et al.* (1996).**

$$\text{Damage grains percent} = \frac{\text{Number of insect damage}}{\text{Number of total grains inspected}} \times 100$$

3. Seed dry weight losses percentage: After 6 months, the dry mass (weight) losses caused by insect infestation were calculated as follows according to **Dick (1987).**

$$\text{Dry mass (weight) loss \%} = \frac{(U\ Nd) - (D\ Nu)}{U\ (Nd + Nu)} \times 100$$

Where: Nu → number of undamaged grains. Nd → number of damaged grains.

U → weight of undamaged grains. D → weight of damaged grains.

4. Fungi infestation percentage. The isolation of fungi associated with the seeds of wheat was carried out using the standard blotter (Scotie-tissue) method as described by the International Seed Testing Association **(ISTA,1999)**. These layers of filter papers (Whatman-9 cm) were soaked in sterile distilled water and placed in sterilized Petri dishes. The relatively healthy seeds were surface sterilized by soaking it in 5% Sodium hypochlorite solution for 10 min and rinsed with sterile distilled water for three consecutive times thereafter, the sterilized seeds were plated on the sterilized Petri dishes and incubated for 7 days in a laboratory bench at room temperature (20±2°C) for wheat seed. The percentage frequency of fungi was calculated as:

$$\text{Fungi infestation (\%)} = \frac{\text{No. of seed containing fungi}}{\text{Total no. of seed assessed}}$$

Statistical Analysis: Collected data were subjected to the statistical analysis as a usual technique of analysis of variance (ANOVA) for the Completely Randomized Design (CRD) as mentioned by Gomez and Gomez (1984), using "MSTAT-C" Computer software package.. The treatment means were compared by using the Newly Least Significant Difference (New L.S.D) method at 5% level of probability as **Waller and Duncan (1969)** by using following formula: New L.S.D = $k \times \bar{Sy}$

RESULTS AND DISCUSSION

1-Effect of seed moisture content:

Presented data in Table 1, show the effect of wheat seed moisture content on the studied traits initially after treatment and after six months from storage. Germination percentage of wheat seed significantly affected by moisture content as illustrated from Table 1. Initially after treatment, the highest mean of germination percentage (93%) was recorded at seed moisture levels 11% and 14%, meanwhile the lowest mean (74%) was recorded at moisture level 17%. Directly after treatment wheat seed was free from any insect infestation, consequently seed dry weight loss did not record any read, meanwhile fungi infestation percentage was increased from 27.3% to 34.6% and 42.6% with increasing seed moisture levels from 11% to 14% and 17% respectively. On the other side, after six month from storage germination percentage of wheat seed significantly decreased with increasing seed moisture content, germination percentage of wheat seed surpassed the acceptance level of certified wheat seed (90%) at moisture levels 11% and (87%) at moisture content 14% meanwhile it decreased to 73% at moisture level 17% From this study, it can be stated that, the higher seed moisture noticed with untreated seeds has resulted in lower seed quality, as higher moisture levels leads to higher respiration rate of seed and thus resulting in reduction seed quality.. Readings of storage pests (insect infestation percentage and fungi infestation percentage) and seed dry weight loss percentage were increased with increasing seed moisture content while, with increasing seed moisture level from 11% to 17% insect infestation percentage, seed dry weight loss percentage and fungi infestation percentage were increased from 3%, 14.6% and 25.5% to 6.6%, 23.8% and 38.0%, respectively. This gradual decline in the quality of seed during storage may be due to ageing effects, leading to depletion of embryo apart from death of seeds because of insect infestation and fungal invasion. These results are in confirmation with Paneru et al. (1993) in wheat.

Table1: Averages of germination percentage, Insect infestation percentage, seed dry weight loss percentage and Fungi infestation percentage of wheat seeds as affected by seed moisture content initially after treatment and after 6 months from storage.

Characters / Seed moisture content	Initially after treatment				After 6 months from storage			
	Germination %	Insect infestation %	Seed dry weight loss %	Fungi infestation %	Germination %	Insect infestation %	Seed dry weight loss %	Fungi infestation %
11%	93	0.0	0.0	27.3	90	3.0	14.6	25.5
14%	93	0.0	0.0	34.6	87	4.5	20.5	31.6
17%	74	0.0	0.0	42.6	73	6.6	23.8	38.0
New L.S.D. at 5%	1	0.0	0.0	1.8	1	0.1	1.0	1.9

2-Effect of seed treatments:

From tabulated data in Table 2, all the studied traits significantly affected by seed treatments, initially after treatment and after six month from storage. Initially after treatment, wheat seed fumigated with 3 Tab/m^3 under relative humidity 37% produced the highest mean of germination percentage (94%) meanwhile, the lowest mean of germination percentage (82%) was obtained from treated seed with neem oil and fumigation under 77% relative humidity, with respect to the effect of seed treatments on fungi infestation percentage, the lowest percentage (2.2%) was produced from (treated with fungicide and fumigation under 37% and 57% relative humidity, respectively), meanwhile the highest percentage of fungi infestation was recorded from untreated seed (62.9%).

Table2: Averages of germination percentage, Insect infestation percentage, seed dry weight loss percentage and Fungi infestation percentage of wheat seeds as affected by seed treatments initially after treatment and after 6 months from storage.

Characters / Seed treatments	Initially after treatment				After 6 months from storage			
	Germination %	Insect infestation %	Seed dry weight loss %	Fungi infestation %	Germination %	Insect infestation %	Seed dry weight loss %	Fungi infestation %
Un treated	87	0.0	0.0	62.9	85	9.2	27.2	60.9
Fungicide	87	0.0	0.0	7.1	82	9.8	31.1	5.8
neem oil	85	0.0	0.0	42.1	79	6.2	23.6	42.2
Fumi. at 37% RH.	94	0.0	0.0	40.2	93	4.1	12.6	33.2
Fumi. at 57% RH.	90	0.0	0.0	49.6	86	3.9	13.8	47.6
Fumi. at 77% RH.	87	0.0	0.0	63.6	83	4.2	19.8	59.1
Fungicide + Fumi. at 37% RH.	87	0.0	0.0	2.2	85	3.8	14.4	1.3
Fungicide + Fumi. at 57% RH.	89	0.0	0.0	2.2	84	3.5	16.2	1.9
Fungicide + Fumi. at 77% RH.	86	0.0	0.0	4.0	82	3.6	20.9	5.0
Neem oil + Fumi. at 37% RH.	83	0.0	0.0	39.4	81	2.8	15.7	35.1
Neem oil + Fumi. at 57% RH.	86	0.0	0.0	47.9	80	2.8	17.9	39.6
Neem oil + Fumi. at 77% RH.	82	0.0	0.0	56.6	78	2.9	22.4	49.0
New L.S.D. at 5%	1	0.0	0.0	3.6	2	0.2	2.0	3.8

After six months from storage, the highest mean of germination percentage (93%) was obtained from fumigation with phosphine at 3 tab/m3 under relative humidity 37%, meanwhile the lowest percent (78%) was recorded from seed treatment (treated with neem oil and fumigation under 77% relative humidity).

Insect infestation percentage of wheat seed reached its highest mean (9.8%) when treated with fungicide also seed dry weight loss percentage (31.1%) was the heaviest. On the other side the lowest percentage of insect infestation (2.8%) was produced from (treated with neem oil and fumigation under 37% relative humidity) and (treated with neem oil and fumigation under 57% relative humidity). Fungi infestation percentage

was decreased from (60.9%) for untreated seed to (1.3%) for (treated with Fungicide and fumigation under 37% relative humidity). The superiority of neem oil is due to the fact that, these treatments keep the seeds intact as it acts as binding material and covers the minor cracks and aberrations on the seed coat at initial stage thus blocking the fungal invasion. Apart from this, the insecticidal property present in the botanicals also helps in making the seeds incompatible for insects during storage (Prakash and Jagadishwari, 1992).

3-Effect of the interaction:

The effect of interaction between seed moisture content and seed treatments on the studied traits initially after treatment was significant only germination and fungi infestation characters as presented in Table 3, the highest mean of germination percentage (99%) was obtained from fumigation wheat seed had moisture level 14%with PH_3 at concentration 3 tab/m^3 under 37% relative humidity. On contrast, the lowest percent of germination (63%) was recorded from treating wheat seed that had 17% moisture level with (neem oil and fumigation under 77% relative humidity). Untreated wheat seed that had moisture content 17% had the highest Fungi infestation percentage (80.7%) meanwhile, treated seed with fungicide and treated seed with (fungicide and fumigation under 37% relative humidity) were free from any fungi infestation at seed moisture level 11%.

Table3: Averages of germination percentage, insect infestation percentage, seed dry weight loss percentage and Fungi infestation percentage of wheat seeds as affected by interactions between seed moisture content and seed treatments initially after treatment.

Characters	Germination percentage			Insect Infestation%			seed dry weight loss%			Fungi infestation %		
Moisture content / Seed treatment	11%	14%	17%	11%	14%	17%	11%	14%	17%	11%	14%	17%
Un treated	98	89	73	0.0	0.0	0.0	0.0	0.0	0.0	39.3	68.7	80.7
Fungicide	98	91	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	14.0
Neem oil	95	90	70	0.0	0.0	0.0	0.0	0.0	0.0	26.0	38.0	62.2
Fumi. at 37% RH.	97	99	85	0.0	0.0	0.0	0.0	0.0	0.0	30.0	41.3	49.3
Fumi. at 57% RH.	93	97	79	0.0	0.0	0.0	0.0	0.0	0.0	44.5	50.1	54.1
Fumi. at 77% RH.	91	97	72	0.0	0.0	0.0	0.0	0.0	0.0	58.2	62.0	70.8
Fungicide + Fumi. at 37% RH.	92	90	77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.5
Fungicide + Fumi. at 57% RH.	93	95	78	0.0	0.0	0.0	0.0	0.0	0.0	1.8	2.1	2.8
Fungicide + Fumi. at 77% RH.	87	91	80	0.0	0.0	0.0	0.0	0.0	0.0	4.0	3.5	4.5
Neem oil + Fumi. at 37% RH.	94	89	67	0.0	0.0	0.0	0.0	0.0	0.0	28.7	38.3	51.3
Neem oil + Fumi. at 57% RH.	94	95	70	0.0	0.0	0.0	0.0	0.0	0.0	42.8	48.3	52.6
Neem oil + Fumi. at 77% RH.	89	94	63	0.0	0.0	0.0	0.0	0.0	0.0	51.8	55.0	63.1
New L.S.D. at 5%	2			0.0			0.0			6.9		

Table4:Averages of germination percentage, Insect infestation percentage, seed dry weight loss percentage and Fungi infestation percentage of wheat seeds as affected by interactions between seed moisture content and seed treatments after 6 months from storage.

Characters	Germination percentage			Insect Infestation%			seed dry weight loss%			Fungi infestation %		
moisture content / Seed treatments	11%	14%	17%	11%	14%	17%	11%	14%	17%	11%	14%	17%
Un treated	92	85	78	7.2	9.2	11.2	19.9	30.0	31.8	37.3	66.7	78.7
Fungicide	87	81	78	9.4	9.0	11.0	27.9	32.4	33.1	0.0	5.3	12.0
Neem oil	84	79	74	4.6	6.0	8.0	19.5	24.9	26.3	24.0	36.0	66.7
Fumi. at 37% RH.	98	98	84	1.5	4.0	6.8	7.7	13.1	17.0	28.0	38.3	33.3
Fumi. at 57% RH.	83	95	79	2.0	3.8	5.8	9.2	14.3	18.0	42.5	48.1	52.1
Fumi. at 77% RH.	83	93	73	2.5	4.5	5.8	15.1	20.0	24.4	56.2	60.0	61.3
Fungicide + Fumi. at 37% RH.	92	90	72	1.6	3.3	6.3	9.6	14.1	19.6	0.0	0.0	4.0
Fungicide + Fumi. at 57% RH.	92	85	76	1.8	3.6	5.1	9.9	16.3	22.3	1.5	1.9	2.3
Fungicide + Fumi. at 77% RH.	88	85	73	2.7	3.1	5.1	16.2	21.7	24.7	3.8	5.5	5.8
Neem oil + Fumi. at 37% RH.	96	83	63	1.0	2.7	4.7	11.0	16.4	19.8	26.7	25.3	53.3
Neem oil + Fumi. at 57% RH.	91	84	66	1.0	2.7	4.7	12.0	18.5	23.3	37.3	40.1	41.3
Neem oil + Fumi. at 77% RH.	90	83	62	1.3	2.7	4.7	17.4	24.7	25.2	49.3	52.3	45.3
New L.S.D. at 5%	3			0.5			3.8			7.3		

Regarding the effect of interaction between seed moisture content and wheat seed treatments after six months from storage, significant effect was obtained on all the studied traits (Table 4). Fumigation wheat seed at moisture levels 11% and 14% with PH_3 at concentration 3 tab./m^3 under 37% relative humidity recorded 98% germination percentage on the other side, the lowest percentage of seed germination (62.0%) was recorded from treating wheat seed at moisture level 17% with (neem oil and fumigation under 77% relative humidity). Insect infestation percentage significantly increased especially with increasing seed moisture content. The highest insect infestation was recorded from untreated wheat seed at moisture level 17%, meanwhile insect infestation recorded the lowest percentage 1% at moisture level 11% after treatments with (neem oil + fumi. at 37% RH.) and (neem oil + Fumi. at 57% RH.). Also from the same Table (4), seed dry weight loss was decreased to the minimum level after treating wheat seed that had 11% moisture content with phosphine at relative humidity 37% after 6 months from storage mean while treated seed that had 17% moisture content with fungicide only or untreated seed recorded the maximum percentage of seed dry weight loss. With respect to the, fungi infestation percentage, it reached its highest percentage in untreated seed that had 17% moisture content whereas wheat seed that had 11% moisture content was completely free from fungi infection when treated with fungicide only. Although synthetic pesticides recommended for control storage pests, but their use may create toxicity to other organisms, development of pest resistance and residues in treated seed. To alleviate insects pest problems in storage, there is a wide interest have been focused on plant derived materials, cause smaller environmental impact but its effective time is short comparing to the synthetic pesticides, so treating stored seed with (fungicide + fumigation with PH3 at relative humidity up to 57%) or (neem oil + fumigation with PH3 at

relative humidity up to 57%) before storage may reduce the disadvantages of using pesticides or plant extracts separate. From the former results, wheat seed c.v. (Sakha 93) could be store in open air with maintain good quality seed at moisture content not excessed 14% after treatment with (fungicide + fumigation with PH_3 at relative humidity up to 57%) or (neem oil + fumigation with PH_3 at relative humidity up to 57%).

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تأثير بعض معاملات التقاوى قبل التخزين على جودة تقاوى القمح

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أقيمت تجربة معملية بمعمل وحدة بحوث تكنولوجيا البذور بالمنصورة – محافظة الدقهلية فى عام ٢٠١٠ لدراسة تأثير محتوى الرطوبة للحبوب (١١، ١٤ و ١٧%) ومعاملات البذور (مبيدات فطرية، مستخلصات نباتية والتبخير) على جودة تقاوى القمح صنف سخا ٩٣ بعد ستة أشهر من التخزين وقد تضمنت التجربة ٣٦ معاملة عبارة عن ثلاثة محتويات رطوبة للحبوب (١١، ١٤ و ١٧%) واثنى عشر معاملة للتقاوى (وهى بدون معاملة ومبيدات فطرية ومستخلصات نباتية ومعاملة التبخير عند ثلاثة مستويات رطوبة نسبية هى ٣٧، ٥٧ و٧٧% وكذلك التفاعل بين معاملة التبخير وكل من المبيد الفطرى وزيت النيم) وتم تصميم التجارب في تصميم تام العشوائية في أربع مكررات.

ويمكن تلخيص أهم النتائج على النحو التالى:-

١- زيادة محتوى الرطوبة في تقاوى القمح قبل التخزين أكثر من ١٤% أدى إلى انخفاض بشكل ملحوظ لنسبة الإنبات وزيادة نسبة الإصابة الفطرية. بعد التخزين لمدة ستة أشهر، انخفضت نسبة الإنبات لتقاوى القمح ذات محتوى رطوبة ١٧% في الوقت نفسه، زيادة آفات المخزن (الإصابة الحشرية والفطرية) ونسبة الفقد في الوزن الجاف.

٢- أشارت النتائج إلى وجود فروق معنوية بين معاملات التقاوى على نسبة الإصابة الحشرية، الفقد في الوزن الجاف ونسبة الإصابة الفطرية، أعطى تبخير التقاوى بالجرعة الموصى بها (٣ أقراص فوسفين/ متر مكعب) تحت أقل مستوى رطوبة نسبية ٣٧% و ٥٧% لمدة ثلاثة أيام فاعلية في المحافظة على جودة تقاوى القمح خلال ستة أشهر.

٣- أوضحت النتائج وجود فروق معنوية للتفاعل بين مستويات الرطوبة للحبوب ومعاملات التقاوى على جميع الصفات المدروسة.

* وتوصى الدراسة للحصول على أعلى جودة لتقاوى القمح (صنف سخا ٩٣) تحت ظروف التخزين في الهواء الطلق من خلال معاملة التقاوى ذات المحتوى من الرطوبة ١٤% (المبيد الفطرى + التبخير بالفوسفين تحت ٥٧% رطوبة نسبية) أو (زيت النيم + التبخير بالفوسفين تحت ٥٧%رطوبة نسبية).

قام بتحكيم البحث

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