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Impact of Pre-Harvesting Spraying Pesticides and Post-Harvesting with Phosphine Fumigation on Germination and Seedling Parameters of Bread Wheat

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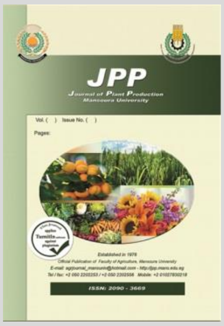

ABSTRACT

Field trial followed by storage experiment were carried out to evaluate the effect of pesticide types and phosphine fumigation doses on germination and seedling parameters of bread wheat cultivar Misr1 (*Triticum aestivum* L.). Both actellic and malathion were applied at the recommended concentration. They were sprayed after 120 and 150 days from cultivation in addition to their control. Treated wheat grains were fumigated at the beginning of storage with phosphine at the dosage rate of 0 (untreated grains), 1, 3 and 5 tablet(s)/m^3 and stored for six months from the 1^{st} of May 2019 to the 31^{st} of Oct. 2019. The results indicated that using actellic or phosphine fumigation with five tablets m^{-3} significantly increased final germination percentage, germination speed index, germination energy, root and shoot length, seedling dry weight and seedling vigor index. Meanwhile, the percentage of rotten and sold grains were significantly reduced. Pre-harvest spraying of wheat plants with actellic with post-harvest fumigation of wheat grains with phosphine at five tablets m^{-3} could be recommended to have the best germination and seedling characters.

Keywords: Pesticide, Phosphine doses, Germination, Seedling, Wheat.

INTRODUCTION

Malathion and actellic is a man-made organophosphate insecticide commonly used to safely control a wide variety of insects. Field foliar application of insecticides may contribute to preventing or at least reducing insect infestation and hence the need for fumigation, which lowers the cost of storage in this respect, Dakshinamurthy and Regupathy (1992) found that malathion was effective but less than one the other insecticides. One spray 20-30 days after 50% flowering was effective. Pre-harvest treatment resulted in increased seed germination. Yenish and Young (2000) stated that soft white spring wheat germination was affected only by herbicides applications at the milk stage with reductions from 2 to 46%, compared to untreated wheat. The crop maturity stage most significantly influenced wheat seed and seedling quality following preharvest herbicides applications at the time of application. Kljajic and Peric (2007) investigated insecticides' toxicity including malathion and pirimiphos–methyl (actellic) to granary weevil *Sitophilus granaries* adults. They found that malathion and pirimiphos-methyl had the least toxic effect on weevils. At the same time, deltamethrin was the most harmful to weevils. Mersal *et al.* (2011) investigated the role of some plant extracts such as malathion and its included mixture on seed quality during different storage periods (0, 6 and 18 months). Treating rice weevils with the recommended dose of malathion decreased germination percentage and seedlings vigor. He *et al.* (2015) conducted field studies to determine the effects of pre-harvest chemical applications on seed germination of hybrid and conventional rice applied at four weeks and six weeks after heading. Results showed that chemical applications had no adverse effects on germination percentage and germination index, but there were negative effects on the percentage of normal seedlings. Draz *et al.* (2016) investigated in a laboratory experiment the effect of malathion insecticide on the physiological and biochemical parameters of rice weevil *Sitophilus oryzea* L. Protein content was significantly increased in the case of malathion insecticide compared with control. Perboni *et al.* (2018) evaluated herbicide application rates at different timings on germination. Regardless of the herbicide and application rate, application in the milk grain to the early and soft dough to hard dough stage provides more excellent germination of wheat seeds, except at the lower dose of one herbicide. Elalfy, Hanaa *et al.* (2019) conducted a field experiment to evaluate the effect of three insecticides and their combination with two adjuvants to control the wheat aphid and onion thrips on wheat plants during two growing seasons. The three tested insecticides included malathion 57% EC. The results showed that malathion and its mixtures caused lower percent mortality than the other two tested insecticides and its mixtures during the two seasons. Swamy and Wesley (2020) studied the extent of field carryover to storage godowns for grain insect pests of rice as initial responsible of insect pest infestations and severe damage to grains. They found that during the first season, 46% of the field-collected paddy grain samples were infested with *Sitotroga cerealella*. In contrast, only 15% of the samples were found with infestation during the second season.

Phosphine is a slow-acting poison that is effective concentrations vary according to exposure time,

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temperature, relative humidity and accompanied co_2 concentration. Usually, minimum exposure times of three days or more are enough to control insects. Krishnasamy and Seshu (1990) evaluated the effect of fumigation with phosphine at different doses on seed germination and seedling vigor in rice (*Oryza sativa* L.). They reported that at the normal recommended dose of 3 g m^{-3}, fumigation did not affect germination or vigor but at 6 g m^{-3}, vigor decreased. The effect became more perceptible after 90 d of storage. Gupta *et al.* (2000) fumigated wheat with 3, 6 and 9 g phosphine m^{-3} for five times at 1-month intervals, stored it for four months. They reported that repeated fumigation had no adverse effect on seed germination and vigour even at the highest dose. Mahmoud *et al.* (2011) said that tested wheat grains varieties could be fumigated with phosphine PH_3 after 24 hours of exposure. After three months, the storage period led to a high germination percentage within all genotypes. Ramadan, Nany (2016) fumigated wheat grains before storage with phosphine with 3, 5 and 7 tablets phosphine/m^3. Phosphine fumigation significantly affected final germination percentage and treating with phosphine at the rate of 5 tablets/m^3 gave the highest final germination percentage. Salama *et al.* (2016) carried out a laboratory experiment to evaluate the effect of fumigation with phosphine at 0, 3, 5 and 7 tablets/m^{-3} on germination and seedlings parameters of wheat. Maximum germination and seedling parameters were obtained from fumigation with phosphine at the rate of 5 tablets/m^2. Badawi *et al.* (2017) concluded that wheat seed viability and quality were significantly affected by increasing storage up to 9 months. The highest seed viability and quality were recorded with fumigated wheat grains with phosphine at eight ppm. Seadh *et al.* (2021) stated that the highest final germination percentage, plumule and radical length, seedling vigor index and seedlings dry weight in addition to the lowest abnormal seedlings percentage, rotten and sold seeds percentages, speed germination index, and germination energy percentage were recorded with phosphine fumigation at the rate of 3 tablets/m after 15 days from beginning the storage.

The main objective of this study was to evaluate the effect of pesticide types and phosphine fumigation doses on germination and seedling parameters of bread wheat.

MATERIALS AND METHODS

The field experiment was conducted at Mansoura district (31.001667° N, 31.379109° E). Storage experiment of the treated produced wheat grains was in Nabaroh Warehouse, (31.091336 N, 31.2468 E). Both locations are in Dakahlia Governorate, Egypt.

The wheat *Triticum aestivum* L. cultivar was Misr 1. After harvesting, about 2.5 kg of wheat grains were stored in jute packages in each replicate. Its moisture content ranged from 12-13%. The experiment was arranged in a factorial experiment in a randomized complete block design (RCBD) with three replications.

The first studied factor was spraying control treatment (spraying with water), actellic at 375 ml/100 liter and malathion at 150 ml / 100 liter. The control treatment was applied with water only at the same amount used with each of the pesticide. Pesticides were sprayed after 120 and 150 days from cultivation using a knapsack motor. The second factor was grain fumigation with phosphine at the beginning of storage at the rates of 0, 1, 3 and tablet(s) / m^3. Fumigation was made under a polyethylene sheet. Fumigation was applied from 28th to 30th April 2019. After 6 months of storage, germination experiment was established at the optimum time to cultivate wheat seeds.

STUDIED CHARACTERS:

After six months of storage, 100 grains were randomized collected for each treatment and germinated according to International Seed Testing Association (ISTA, 1996) on top filter paper in sterilized Petri-dishes (14 cm diameter); each Petri-dish contains 25 seeds.

The germinated grains were counted, and the first count was defined as the number of germinated grains on the fourth day. After that, the number of germinated grains was counted every 24 hours until the end of the germination test (after eight days). The recorded traits were:

1.Final germination percentage (FG %):

Normal seedlings of each replicate were counted at the end of the standard germination test and expressed as a percentage according to the following equation:

$$\text{FG \%} = \frac{\text{No.of normal seedlings}}{\text{No.of total grains}} \times 100$$

2.Abnormal seedlings percentage (AS%)

Abnormal seedlings of each replicate were counted at the end of the standard germination test and expressed as a percentage according to the following equation described by ISTA (1996):

$$\text{AS\%} = \frac{\text{No.of abnormal seedlings}}{\text{No.of total grains}} \times 100$$

3.Speed germination index (SGI):

The following formula calculated it:

$$\text{SGI} = \frac{\text{No.of germinated grains}}{\text{Days to first count}} + \frac{\dots\dots}{\dots\dots} + \frac{\text{No.of germinated grains}}{\text{Days to final count}}$$

4. Germination energy percentage (GE %): It was calculated by counting the germinating grains at the first count (4 days after sowing) and relative them to the total number of tested seeds as described by Ruan *et al.* (2002).

5.Rotten grains percentage (RGP%): wheat grains that have mildewed were counted after eight days and attributed their numbers to 100 germination tested grans.

6.Sold grains percentage (SGP%): wheat grains that show no evidence of germination except swallowing after eight days were counted and expressed by their numbers in each 100 grans.

7.Root length: At the end of the standard germination test, averages of root length of ten seedlings randomly per replicate were measured from the root origin in seed to the tip of the root and recorded in centimeters (cm) as the root length.

8.Shoot length: Averages of shoot length of ten seedlings were taken at random per each replicate from the seed to the tip of the leaf blade and expressed in centimeters (cm) as the shoot length at the end of the standard germination test.

9.Seedlings dry weight: Ten random seedlings for each replicate were dried in the oven at 70 º C until constant weight. Seedlings were weighted in gram (g).

10. Seedling vigor index (SVI): It was calculated according to the formula of AbdulBaki and Anderson (1973):

$$\text{SVI} = \frac{(\text{Shoot length} + \text{Root length}) \times \text{Germination percentage}}{100}$$

Statistical analysis: Data were statistically analyzed according to the analysis of variance (ANOVA) for the factorial experiment in completely randomized design (RCRD) as published by Gomez and Gomez (1984) using a computer software package of "MSTAT-C". Least significant difference (LSD) method was used to test the differences between treatment means at a 5% level of probability as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSIONS

Means of final germination percentage, abnormal seedlings percentage, speed germination index, germination energy and rotten grains percentage as affected by pesticide types and phosphine fumigation doses are presented in Table 1.

The presented results in Table 1 showed that pesticide types had a significant effect on all traits except for abnormal seedlings percentage. In contrast, all traits were significantly affected by phosphine fumigation doses.

1. Final germination percentage:

As presented in Table 1, the results indicated that spraying actellic (92.75 %) surpassed spraying both malathion (90.00 %) by 3.06% and control (87.17%) by 6.02% in germination percentage.

Increasing phosphine fumigation doses up to 5 tablets m^{-3} significantly increased germination percentage. The highest percentage of germination (91.83 %) was obtained from 5 tablets m^{-3} fumigation. The lowest germination percentage (88.39 %) was produced from no fumigation treatment. These results may explain to the effect of phosphine in resistance insect pests and maintain their embryo and stored nutrients safe until germination time.

As shown in Table 1, the interaction between pesticide types with phosphine fumigation doses significantly affected the final germination percentage.

Table 1. Final germination percentage, abnormal seedlings percentage, speed germination index, germination energy percentage and rotten grains percentage as affected by dates of pesticide spraying, pesticide types and phosphine fumigation doses.

Treatment	Character				
	Final germination (%)	Abnormal seedlings (%)	Speed germination index	Germination energy %	Rotten grains %
A. Pesticide types					
Control	87.17	1.58	17.82	70.54	4.00
Actellic	92.75	1.75	19.48	71.75	2.13
Malathion	90.00	1.46	18.63	71.08	3.75
F. test	*	NS	*	*	*
L.S.D. at 5%	0.28	-	0.08	0.18	0.21
B. Phosphine fumigation doses					
Control	88.39	1.00	18.28	70.78	4.67
1 tablet m^{-3}	89.33	2.44	18.60	71.11	2.00
3 tablets m^{-3}	90.33	1.67	18.87	71.39	3.61
5 tablets m^{-3}	91.83	1.28	18.92	71.22	2.89
F. test	*	*	*	*	*
L.S.D. at 5%	0.32	0.25	0.09	0.20	0.25
E. The Interaction	*	NS	*	NS	*

***, and NS indicates P< 0.05 and not significant, respectively.**

The interaction between pesticide types and phosphine fumigation doses significantly affected the final germination percentage as presented in Table 2.

The highest percentage of germination was obtained from spraying actellic with five tablets m^{-3} fumigation (94.33%), but the lowest percentage of final germination (84.50%) was produced from water-free pesticide with no fumigation.

Table 2. The interaction between pesticide types and phosphine fumigation doses as affected the final germination percentage in wheat grains.

Phosphine fumigation doses	Pesticide types		
	Control	Actellic	Malathion
Control	84.50	91.83	88.83
1 tablet m^{-3}	87.33	91.17	89.50
3 tablets m^{-3}	87.50	93.67	89.83
5 tablets m^{-3}	89.33	94.33	91.83
L.S.D. at 5%		0.55	

2. Abnormal seedlings percentage:

As presented in Table 1, the results indicated that treating wheat with phosphine dose of 5 tablets m^{-3} caused the highest percentage of abnormal seedling (2.44%), whereas unfumigated wheat recorded the lowest percentage of abnormal seedlings (1.00%). Fumigation with five tablets m^{-3} surpassed control treatment in abnormal seedling percentage by 144.0%.

As shown in Table 1, the interaction insignificantly affected abnormal seedlings percentage.

3. Speed germination index:

Using actellic recorded the highest speed germination index (19.48) compared with control treatment which recorded the lowest (17.82) with an increasing average of 9.7%.

Treating wheat with five tablets m^{-3} had the highest speed germination index (18.92), whereas unfumigated wheat recorded the lowest speed germination index (17.28). Fumigation with five tablets m^{-3} surpassed control in speed germination index by 9.5%.

The interaction between pesticide types and phosphine fumigation doses significantly affected speed germination index as placed in Table 3. The interaction between using actellic with 1, 3 and 5 tablets m^{-3} phosphine fumigation had the best speed germination index of 19.67, 19.58 and 19.54, respectively with no significant differences among them. Whoever, using water-free pesticides (control) with both 1 and 3 tablets phosphine fumigation recorded the lowest speed germination index of 17.50 and 17.54, respectively with no significant difference between them.

Table 3. Speed germination index as affected by the interaction between pesticide types and phosphine fumigation doses.

Phosphine fumigation doses	Pesticide types		
	Control	Actellic	Malathion
Control	17.50	19.13	18.21
1 tablet m^{-3}	17.54	19.67	18.58
3 tablets m^{-3}	18.08	19.58	18.67
5 tablets m^{-3}	18.17	19.54	19.04
L.S.D. at 5%		0.15	

4. Germination energy percentage:

Spraying actellic treatment recorded the highest germination energy percentage of 71.75%. Control treatment came in the last rank, recording 70.54%.

The highest germination energy percentage (71.39% and 71.22%) was obtained from fumigation with 3 and 5 tablets m^{-3}, respectively. The lowest germination energy (70.78 %) was produced from no phosphine fumigation.

As shown in Table 1, only the interactions between pesticide types with fumigation phosphine doses had an insignificant effect on germination energy percentage.

5. Rotten grains percentage:

The results indicated that untreated wheat (control) had the highest rotten grains percentage (4.00%) compared with the lowest came from spraying actellic (2.13%) (Table 1). It's clear that treating with actellic reduced rotten grains percentage by 46.8% than control. These results may be explained due to higher vital embryo with actellic usage through its role as an effective pesticide.

The results indicated that using control phosphine fumigation dose of 0 tablet m^{-3} recorded the highest rotten grains percentage of 4.67%. In contrast, phosphine fumigation doses of five tablets m^{-3} recorded the lowest rotten grains percentage of 2.89% with a decrease average of 57.2%.

This may be due to the lethal effect of phosphine on storage insects (in higher concentrations), which reduces embryo harm by insects.

As shown in Table 1, the interactions between pesticide types with phosphine fumigation doses significantly affected rotten grains percentage.

The significant interaction effect between pesticide types and phosphine fumigation doses on rotten grains percentage are presented in Table 4. The highest percentages of rotten grains (5.33%) was recorded from using both control treatment and malathion with no fumigation. The lowest percentage was produced from using actellic at 1, 3 and 5 tablet(s) m^{-3} fumigation or malathion with 1 tablet m^{-3} fumigation.

Table 4. Rotten grains percentage as affected by the interaction between pesticide types and phosphine fumigation doses.

Phosphine fumigation doses	Pesticide types: Control	Actellic	Malathion
Control	5.33	3.33	5.33
1 tablet m^{-3}	2.50	1.50	2.00
3 tablets m^{-3}	4.50	2.00	4.50
5 tablets m^{-3}	3.67	1.67	3.33
L.S.D. at 5%		0.43	

6. Sold grains percentage:

As presented in Table 7, spraying water-free pesticides significantly surpassed spraying both malathion and actellic in sold grains percentage, where control treatment recorded 7.25% followed by spraying malathion recoded 4.75% and spraying actellic came in the last rank recording 3.38%.

The results clearly showed that phosphine fumigation doses significantly affected sold grains percentage. Increasing phosphine fumigation doses significantly decreased sold grains percentage. The highest percentage of sold grains (6.22% and 5.94%) was obtained from 1 and 0 tablet m^{-3} fumigation with insignificant differences, but the lowest (4.00 %) was produced from 5 tablets m^{-3}.

The interactions between pesticide types and phosphine fumigation doses were significant as presented in Table 5, the interaction between no fumigation (control) and spraying water-free pesticide (control) recorded the highest sold grains percentage (9.17%), whoever using either 3 or 5 tablets m^{-3} fumigation with spraying actellic had the lowest loss percentage of sold grains percentage (2.67%).

Table 5. Sold grains percentage as affected by the interaction between pesticide types and phosphine fumigation doses.

Phosphine fumigation doses	Pesticide types: Control	Actellic	Malathion
Control	9.17	3.83	4.83
1 tablet m^{-3}	8.00	4.33	6.33
3 tablets m^{-3}	6.17	2.67	4.17
5 tablets m^{-3}	5.67	2.67	3.67
L.S.D. at 5%		0.52	

7. Root length (cm):

As shown in Table 7, actellic recorded the tallest root length (6.67 cm) compared with control treatment which recorded the lowest (6.38 cm) with an increasing average of 4.6%. This may be caused by the capability of actellic against seed attacks to maintain much-stored nutrients for the embryo to use.

Treated wheat with five tablets m^{-3} had the tallest root length (6.64 cm), whereas unfumigated wheat recorded the shortest root length (6.43 cm), which refers to a 3.3% increase in root length. These results may be explained due to fumigation's role in protecting nutrients against insect attacks.

As shown in Table 1, the interactions between pesticide types and phosphine fumigation doses significantly affected root length.

Means of root length (cm) as significantly affected by the interaction between pesticide types and phosphine fumigation doses are placed in Table 6. The interaction between all fumigation doses with spraying actellic as well as spraying malathion with 1, 3 and 5 tablet(s) m^{-3}, also control pesticide treatment with five tablets m^{-3} recorded the tallest root length (cm) with insignificant differences among them. Whoever, water-free pesticide (control) with 0 or 1 phosphine fumigation recorded the shortest root length (cm).

Table 6. Root length (cm) and shoot length (cm) as affected by the interaction between pesticide types and phosphine fumigation doses.

Phosphine fumigation doses	Pesticide types: Control	Actellic	Malathion
Control	6.19	6.60	6.49
1 tablet m^{-3}	6.34	6.64	6.55
3 tablets m^{-3}	6.43	6.69	6.58
5 tablets m^{-3}	6.56	6.75	6.61
L.S.D. at 5%		0. 23	

8. Shoot length (cm):

Untreated wheat (control) had the shortest shoot length (9.12 cm) compared with the tallest (9. 52 cm) came from spraying actellic. It's clear that treating with actellic increased shoot length (cm) by 4.4% than control (Table 7).

Using phosphine fumigation dose of 5 tablets m^{-3} recorded the highest value of shoot length (9.50 cm). In contrast, control phosphine fumigation recorded the lowest value of shoot length (9.17 cm) with decrease average of 3.5%.

As shown in Table 7, the interactions between pesticide types and phosphine fumigation doses significantly affected shoot length (cm).

Table 7. Sold grains percentage, root length (cm), shoot length (cm), seedling vigor index and seedling dry weight (g) and abnormal seedlings percentage as affected by dates of pesticide spraying, pesticide types and phosphine fumigation doses.

Treatment	Character				
	Sold grains %	Root length (cm)	Shoot length (cm)	Seedling vigor index	Seedling dry weight (g)
A. Pesticide types					
Control	7.25	6.38	9.12	13.52	0.500
Actellic	3.38	6.67	9.52	15.02	0.525
Malathion	4.75	6.56	9.38	14.34	0.517
F. test	*	*	*	*	*
L.S.D. at 5%	0.26	0.01	0.02	0.06	0.001
B. Phosphine fumigation doses					
Control	5.94	6.43	9.17	13.80	0.503
1 tablet m^{-3}	6.22	6.51	9.30	14.42	0.512
3 tablets m^{-3}	4.33	6.57	9.40	14.29	0.517
5 tablets m^{-3}	4.00	6.64	9.50	14.67	0.524
F. test	*	*	*	*	*
L.S.D. at 5%	0.30	0.01	0.02	0.07	0.001
C. The Interaction	*	*	*	*	*

***, and NS indicates P< 0.05 and not significant, respectively.**

As presented in Table 8, the interaction between no fumigation (control) and spraying water-free pesticide (control) recorded the shortest shoot length (8.83 cm). Using five tablets m^{-3} fumigation with spraying actellic had the tallest shoot length (9.64 cm).

Table 8. Shoot length (cm) as affected by the interaction between pesticide types and phosphine fumigation doses.

Phosphine fumigation doses	Pesticide types		
	Control	Actellic	Malathion
Control	8.83	9.41	9.27
1 tablet m^{-3}	9.07	9.48	9.37
3 tablets m^{-3}	9.21	9.57	9.42
5 tablets m^{-3}	9.38	9.64	9.47
L.S.D. at 5%		0.04	

9. Seedling vigor index:

Spraying actellic treatment recorded the highest seedling vigor index of 15.02 followed by spraying malathion recoded 14.34 and control treatment came in the last rank recording 13.52 (Table 7).

The highest seedling vigor index (14.67) was obtained from five tablets m^{-3} fumigation. Control fumigation treatment produced the lowest seedling vigor index (13.80).

The interactions between pesticide types and phosphine fumigation doses significantly affected seedling vigor index.

As presented in Table 9, the interaction between no fumigation (control) and spraying water-free pesticide (control) recorded the lowest seedling vigor index (12.70). Whoever, using five tablets m^{-3} fumigation with spraying actellic had the highest seedling vigor index (15.34).

Table 9. Seedling vigor index as affected by the interaction between pesticide types and phosphine fumigation doses.

Phosphine fumigation doses	Pesticide types		
	Control	Actellic	Malathion
Control	12.70	14.70	14.00
1 tablet m^{-3}	13.92	14.95	14.39
3 tablets m^{-3}	13.49	15.10	14.28
5 tablets m^{-3}	13.98	15.34	14.69
L.S.D. at 5%		0.17	

10. Seedling dry weight (g):

Using actellic recorded the highest seedling dry weight (0.525 g) compared with control treatment, which recorded the lowest seedling dry weight (0.500 g) with an increasing average of 1.4% (Table 7).

Treated wheat with three tablets m^{-3} gave the highest seedling dry weight (0.524 g), whereas five tablets m^{-3} fumigated wheat recorded the lowest seedling dry weight (0.524 g).

The interaction between pesticide types and phosphine fumigation doses significantly affected seedling dry weight (g), as presented in Table 10. The interaction between no fumigation (control) and spraying water-free pesticide (control) recorded the lowest seedling dry weight (0.485 g). Whoever, using both 3 and 5 tablets m^{-3} fumigation with spraying actellic had the heaviest seedling dry weight (0.529 g and 0.531 g, respectively).

Table 10. Seedling dry weight (g) as affected by the interaction between pesticide types and phosphine fumigation doses.

Phosphine fumigation doses	Pesticide types		
	Control	Actellic	Malathion
Control	0.485	0.517	0.508
1 tablet m^{-3}	0.497	0.523	0.514
3 tablets m^{-3}	0.505	0.529	0.517
5 tablets m^{-3}	0.514	0.531	0.527
L.S.D. at 5%		0.002	

CONCLUSION

From the obtained results, it could be recommended that wheat can be pre-harvested sprayed with actellic and phosphine fumigated post-harvested with five tablets/m^3 to have the greatest wheat germination percentage with the best seedling characters.

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تأثير الرش بالمبيدات قبل الحصاد و التبخير بالفوسفين بعد الحصاد على انبات و صفات بادرات القمح

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أجريت تجربة حقلية متبوعة بتجربة تخزين القمح لدراسة تأثير كل من الرش بالمبيدات الحشرية و جرعات التبخير المختلفة بغاز الفوسفين على صفات الانبات و البادرات خلال الفترة من الاول من شهر مايو 2019 وحتى نهاية شهر اكتوبر 2019. تم استخدام صنف القمح مصر 1 واستخدمت 4 تركيزات من غاز الفوسفين هي 0, 1, 3 و 5 أقراص/م^3 وتم التبخير مباشرة قبل التخزين. تم سحب العينات و اخذ القياسات بعد 6 شهور من بداية التخزين. استخدم التصميم القطاعات كاملة العشوائية كتجربة عامليه ذو ثلاث مكررات و تم قياس صفات كل من النسبة المئوية لكل من الإنبات – البادرات الشاذة – الحبوب المتعفنة - الحبوب الصلدة بالإضافة الى معامل سرعة الانبات - طاقة الانبات – طول الجذر – طول الريشة – الوزن الجاف للبادرة و معامل قوة البادرات. اوضحت النتائج المتحصل عليها وجود اختلافات معنوية بين رش المبيدات المختلفة قبل الحصاد فى كافة الصفات المدروسة عدا صفة النسبة المئوية للبادرات الشاذة وان استخدام الأكتيلك ادى الى زيادة معنوية لصفات النسبة المئوية الإنبات - معامل سرعة الانبات - طاقة الانبات – طول الجذر – طول الريشة – الوزن الجاف للبادرة ومعامل قوة البادرات ونقص معنوي لصفات النسبة المئوية للحبوب المتعفنة والحبوب الصلدة. كذلك فقد اوضحت النتائج وجود اختلافات معنوية بين جرعات التبخير المختلفة باستخدام غاز الفوسفين فى كافة الصفات المدروسة و ان استخدام جرعة التبخير بغاز الفوسفين بمعدل 5 اقراص/م^3 ادت الى افضل النتائج فى كافة الصفات المدروسة. ايضا وجدت اختلافات معنوية نتيجة التفاعل بين انواع المبيدات و جرعات التبخير باستخدام الفوسفين لكافة الصفات المدروسة ما عدا صفتي النسبة المئوية للبادرات الشاذة و معامل سرعة الانبات. توصى الدراسة معاملة القمح باستخدام الرش بالأكتيلك قبل الحصاد و استخدام التبخير بالفوسفين بمعدل 5 اقراص/م^3 بعد الحصاد للحصول على أفضل نسبة انبات وأفضل خصائص للبادرات الناتجة.