Zagazig J.Agric. Res., Vol. 30 No.(6) 2003 **2155-2182**

DEPLETION AND LOSSES IN WEIGHT OF GARLIC CLOVES IN RELATION TO FUNGI AND OTHER FACTORS DURING STORAGE

Khaled, S.A.; M.S-Abd El-Megid; S.M. Moursi and Azza M.A.Sharaf El-Din

Plant Pathol. Res. Inst., Agric. Res. Center, El-Giza, Egypt.

Received 29 / 5 / 2003 ***Accepted 11 / 10 / 2003***

ABSTRACT: Fungi, different temperatures, packing materials, different levels of NPK and growth regulators, were evaluated for their effect on depletion and losses of garlic cloves during storage prolonged for six months. Fungi detected from depleted garlic cloves collected from different localities showed to be the cause various levels of weight loss of garlic bulb inducing garlic depletion through storage. *Aspergillus niger* was superior in this respect. Stored garlic bulb at 5°C exhibited the lowest losses in bulb weight and percentage of depleted cloves. Packing of garlic bulbs in plastic nets showed the lowest losses in bulb weight during storage. In field experiments. NPK ratios that contained higher potassium and or phosphorous exhibited, in general, the lowest losses in bulb weight and depleted cloves during storage. Among the three growth regulators investigated, Gibbrelic acid was the best for decreasing depletion and also, showed the lowest losses in bulb weight during storage, followed by Cicocel. While, Somart was the least effective one.

Key words: Garlic cloves, depletion, fungi, storage factors, fertilization.

INTRODUCTION

Garlic (*Allium sativum* L.) is one of the most important vegetable crops in Egypt. Numerous storage diseases attack garlic bulbs causing decay subsequently resulting in considerable losses and decreased in quality (Bottcher and Pohle, 1991). Garlic diseases as reported by Pinto and Maffia, 1995 in Brazil, were caused by *Puccinia allii*, *Alternaria porri*, *Sclerotium cepivorum*, *Pyrenochaeta terrestris*, *Fusarium solani*, *F. oxysporum* f.sp. *cepae*, *Penicillium* sp., *P. viridicatum*, *Embellisia allii*, *Aspergillus niger*, *A. repens* and *A. sclerotium*.

Stored garlic bulbs cv. Blanco Piacentino for 160 days in 1981 and 100 days in 1982 at 0, 5, 10, 15, 20, 25 and 30°C, dormancy was maintained at 0 and 30°C. Temperature of 15°C stimulated early interruption of dormancy. Infection with *Aspergillus* sp., *Fusarium* sp. and *Penicillium* sp. was slight in all cases but it was more marked at 25 and 30 °C (Folchi and Mari, 1984), whereas, Ragab *et al*. (1984) found that, the optimum temperature for development of *F. solani* in the cloves of cv. Balady was 25°C. They also found that, inoculated bulbs showed considerable weight reduction after storage. Barakat *et al*. (1985) stated that cloves from depleted bulbs which had been stored for 6 month yielded different microorganisms including *Bacillus fumigatus*, *B. subtilis*, *Erwinia caratovora*, *Aspergillus niger* and *Fusarium oxysporum*. Rath and Mohanty (1986) found that, *F. oxysporum* and *F. solani* caused equal damage during the pathogenicity test and a complete rot of inoculated cloves was noticed at 35°C and 100% RH. Abdel-Al *et al*. (1991) indicated that *Aspergillus niger* and *Penicillium chrysogenum* followed by *Acremonium kiliense* and *Fusarium oxysporum* were the most pathogenic fungi causing garlic rots during storage. Also, they reported that, perforated paper bags and carton boxes were better for storage compared with non-perforated ones.

Koltunov (1984) revealed that, farmyard manure at 40 ton/ha plus $N_1P_1K_2$ (=60:60:120 kg/ha) gave the best yield of garlic bulbs suitable for long term storage. On the other hand, Abd El-Megid (1994) stated that, various levels of nitrogenous fertilization (urea, ammonium nitrate and ammonium sulphate) decreased garlic infection with white rot, basal stem rot and blue mold diseases compared with the control.

Garlic bulbs sprayed with mallic hydrazide (2500-5000ppm) two weeks before harvesting caused a reduction of sprouting in storage up to 300 days (Omar and Arafa, 1979). Elian *et al*. (1990) revealed that percentage of emaciation was significantly decreased by the use of growth regulators (Alar and GA_3). The effect was superior in this respect as compared with Cicocel. The same authors added that, sprouting was significantly decreased when the growth regulators were applied to garlic plants.

The aim of this work was carried out to study some factors *i.e.* temperature, packing materials, NPK levels, growth regulators and pathogenic fungi on garlic cloves depletion and losses.

MATERIALS AND METHODS

- Isolation and identification:

Samples of Chinese garlic bulbs collected from El-Giza, El-Qalubyia, Beni-Sweif and El-Ismailia governorates. Cloves of each bulb were randomly chosen for each source. Cloves of each bulb were amputated from their corresponding stems and later peeled off. Isolation procedures were carried out from the apparently depleted cloves, their abscission zones and from small pieces of the dwarf stems. The samples were surface sterilized by immersing in 0.2 sodium hypochlorite solution for ca. Three minutes washed thoroughly in sterilized water, surface dried on sterilized filter papers.

The samples were transferred onto PDA medium in Petri-dishes, three pieces per plate, and incubated at 25°C for seven days. The emerged fungi were purified, using single spore or hyphal tip techniques (Keitt, 1915 and Brown, 1924). The purified isolates were identified by their morphological characters and according to the keys designed by Satour (1960), Booth (1971), Barnett (1972), Ramirez (1982), Samson and Pitt (1990) and Singh *et al.* (1991).

- Pathogenicity tests:

Peeled cloves and garlic bulbs were tested for their susceptibility with each of the isolated fungi to inoculate cloves; they were placed onto 7-day-old PDA culture of the described fungus. Five cloves were placed in each dish and three replicate dishes were used for each treatment. All treatments were incubated at 30°C for ten days, after which the results were recorded according to the disease assessment mentioned later.

To inoculate bulbs, apparently healthy bulbs were selected for their uniformity and of the same size as possible. Roots of each bulb were amputated and then the bulbs were placed vertically in convenient vessels. For surface sterilization, sodium hypochlorite was poured to cover the basal third of the and left for 5 minutes after which they were washed three times by changing the solutions into the vessels. For inoculation, spore suspension (50000 spores/ml) of he desired fungus was poured around the bulbs; the suspension covered the basal third of the bulbs. The bulbs were drained well. Proper controls were also prepared. The bulbs were placed in plastic bags for two days to keep high moisture conditions necessary for spore germination and penetration. In case of inoculation with *Sclerotium rolfsii*, suspension of hyphal fragment, 50000 cfu/ml was used and all steps followed were the same as the other fungi-producing spores. Bulbs of all treatments were kept at room temperature (25-30°C) for 30-60 days, after which the results were recorded as mentioned later under disease assessment. Re-isolation procedures were carried out from dwarf stems, abscission zones and cloves of each bulb for all treatments.

- Effect of temperature and packing materials on bulb depletion through storage:

The effect of different degrees of temperature, *i.e.* 5, 10, 20, 30 and 40°C on the occurrence of depletion phenomenon was studied. Twenty-five bulbs apparently healthy collected shortly after harvest, were weighted individually for each treatment, the bulbs for each particular treatment (5, 10, 20, 30 and 40°C) were placed in perforated paper bags. The percentage of loss in each bulb was determined after 3 and 6 months storage. The percentages of depleted cloves were also estimated.

The effect of packing materials on the average loss in wt. bulbs was carried out at room temperature (25-30°C). Garlic bulbs were collected as mentioned before. Four types of package (plastic package, holed plastic package, paper bags packages and plastic net package) were used. The percentages of loss in weight of each bulb were determined after 3 and 6 months storage and the averages were calculated.

- Effect of various levels of NPK, under field conditions on garlic depletion during storage:

This experiment was carried out under field conditions for two successive seasons (2000/2001 and 2001/2002) at the Experimental Station in Barrage, El-Qalubyia governorate. The complete randomized block design with experimental plot was 3 x 4 ($^1/_{350}$ feddan) was used in this study. All agricultural practices were conducted as usual except NPK fertilizers. The apparently healthy cloves were soaked for dis-infection in Sumisclex, 0.02% for 20 min. Ammonium nitrate, calcium super phosphate and potassium sulphate were added at different levels shown in Table (1). The fertilizers were added at three intervals: *i.e.* 30, 60 and 90 days from planting, control plots without fertilizers served as control. Two hundred cloves of garlic were sown in each plot. Sixty bulbs from each treatment were taken after harvest and stored for 6 months at 10-12°C and/or 25-30 °C (room temperature).

- Effect of growth regulators on garlic bulb depletion during storage:

This experiment was carried out in the field at Quassassin (El-Ismailia) Experimental Station. Plots of the experiment were prepared in the same way as mentioned for NPK experiment. The experiment was conducted in season of 2000/2001 and repeated in 2001/2002 season. Apparently healthy cloves were sown in early of October when the plants reached 3, 4 and 5 months old, they sprayed with 50, 100 and 200 ppm of Gibbrelic acid; 100, 200, 300 ppm of Cicocel and 25, 50 and 100 ppm of Somart. Untreated plants served as control. The percentages of loss in bulb wt. were determined monthly, as compared with the original wt. after harvest.

RESULTS AND DISCUSSION

- Fungi isolated and their frequency:

Results obtained are shown in Table (2). Among fungal species, *Aspergillus niger, Penicillium chrysogenum* and *Fusarium oxysporum* were the most frequent, being 36.9, 55.71 and 79.44, respectively. The total percentages of frequency at the level of all governorates were 9.23, 14.90 and 19.90, respectively. *Sclerotium rolfsii* was isolated for the first time from garlic cloves taken from depleted bulbs of El-Giza only, and percentage of isolation was 6.09. The same trend of the results were obtained for each governorate. Isolation from the other parts of the bulbs, dwarf stem and abscission zones yielded the same fungi, but their frequencies were not determined.

Table (1): NPK fertilization levels.

Fertilizer N	Fertilizer P	Fertilizer K	Ammonium nitrate (N) kg/f.	Calcium super phosphate (P) kg/f.	Potassium sulphate (K) kg/f.
N_1	P_1	K_1	200	250	62.5
		K_2	200	250	125.0
		K_3	200	250	187.5
	P_2	K_1	200	500	62.5
		K_2	200	500	125.0
		K_3	200	500	187.5
	P_3	K_1	200	750	62.5
		K_2	200	750	125.0
		K_3	200	750	187.5
N_2	P_1	K_1	400	250	62.5
		K_2	400	250	125.0
		K_3	400	250	187.5
	P_2	K_1	400	500	62.5
		K_2	400	500	125.0
		K_3	400	500	187.5
	P_3	K_1	400	750	62.5
		K_2	400	750	125.0
		K_3	400	750	187.5
N_3	P_1	K_1	600	250	62.5
		K_2	600	250	125.0
		K_3	600	250	187.5
	P_2	K_1	600	500	62.5
		K_2	600	500	125.0
		K_3	600	500	187.5
	P_3	K_1	600	750	62.5
		K_2	600	750	125.0
		K_3	600	750	187.5
Without NPK			0	0	0

Table (2): Fungi isolated from depleted cloves of bulbs*, collected from different governorates, and their % frequencies.

Fungi isolated	Governorate				Total	%
	Beni-Sweif	El-Giza	El-Qalubyia	El-Ismailia		
*Fusarium oxysporum***	11.13	9.86	8.50	7.41	36.90	9.23
Fusarium solani	9.66	6.74	6.58	6.73	29.71	7.43
Fusarium moniliforme	2.74	2.16	0.56	3.70	9.16	2.30
Fusarium roseum	0.84	1.44	1.31	5.05	8.64	2.20
Fusarium spp.	10.29	12.02	10.82	12.46	45.59	11.40
Penicillium chrysogenum **	16.39	18.03	12.82	12.46	59.70	14.90
Penicillium spp.	10.29	10.82	12.69	10.44	44.24	11.10
Helminthosporium allii	2.73	0.00	2.56	0.00	5.29	1.30
Alternaria solani	1.89	2.16	2.61	4.04	10.70	2.70
Botrytis allii	2.31	0.72	1.49	1.35	5.87	1.50
Aspergillus niger **	16.81	15.63	24.44	22.56	79.44	19.90
Aspergillus flavus	5.04	6.49	4.29	11.11	26.93	6.70
Rhizoctonia solani	4.41	1.44	6.75	0.67	13.27	3.32
Sclerotium cepivorum	5.25	6.97	6.53	6.06	24.81	6.20
Sclerotium rolfsii ***	0.00	5.29	0.80	0.00	6.09	1.52
Total	99.78	99.77	102.80	104.00	406.35	101.6

* Isolation from the other parts of the bulbs yielded the same fungi.
** Four isolates each.
*** One isolate.

These differences in the infection of bulbs/cloves with different fungi are probably due to: (a) Differences in soil type. (b) Differences in the ability of the fungi to colonize root/bulbs rhizosphere. Root of garlic could probably secrete materials (sugars, amino acids or others) which might favour infection with particular fungus at any stage of plant growth. (c) Source and nature of cloves originally sown for the crop of the new season. (d) Agricultural practices among of which are NPK fertilizers, the most important. These results are similar to results obtained by Kararah and El-Tobshy, Zeinab (1979a and 1979b); Radwan (1980) Abdel-Al *et al.* (1991); and Martinez and Granda (1993).

- Pathogenicity tests:

Isolates of the four chosen fungi were pathogenic and virulent (Fig. 1). The percentages of infection caused by isolates of *A. niger*, *F. oxysporum* and *P. chrysogenum* were ranged from 68-100, 56-84 and 44-92, respectively. Inoculation with *S. rolfsii* scored 100% infection. Data of disease incidence were much the same as those % infections. It is worth mentioned that isolate 1 of each fungal sp. was the most virulent, fluctuated from 79.2 to 93.6 for the different fungi. Therefore, isolate 1 of each of the four fungi were used in the subsequent work.

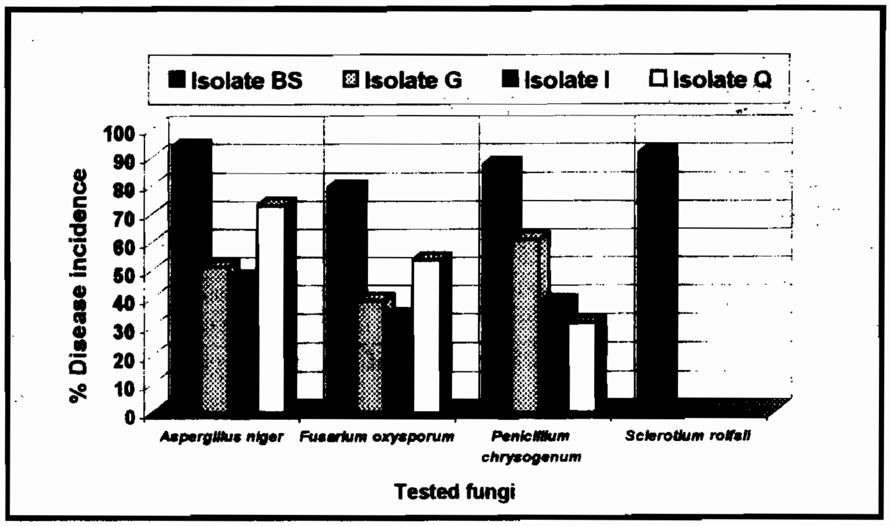

Fig. (1): Disease indexes in garlic cloves artificially inoculated with different fungi, BS, G, I and Q represent Beni-Sweif, El-Giza, El-Ismailia and El-Qalubyia, respectively.

The four fungi were able to induce loss in bulb weight, when artificially inoculated (Fig. 2). The percentages of loss, by the four fungi ranged from 9.27 to 15.32 after 30 days incubation, and from 22.35 to 34.68 after 60 days incubation. In the control treatment, the corresponding figures were 6.21 and 12.61. The lowest percentage of loss was recorded in bulbs, which had inoculated; by *S. rolfsii* while the highest was caused by *P. chrysogenum*. Though no much difference in % loss caused by *F. oxysporum, A. niger, P. chrysogenum* (Fig. 2).

These results were attributed with **Yoo *et al.* (1989).** They stated that total weight loss of onion bulb (Texas Grano 1015Y) ranged from 1.5 to 8.2% at 8 weeks, except at 34 °C storage where 75% was lost primarily through decay at 1, 7, 13, 20, 27 or 34 °C.

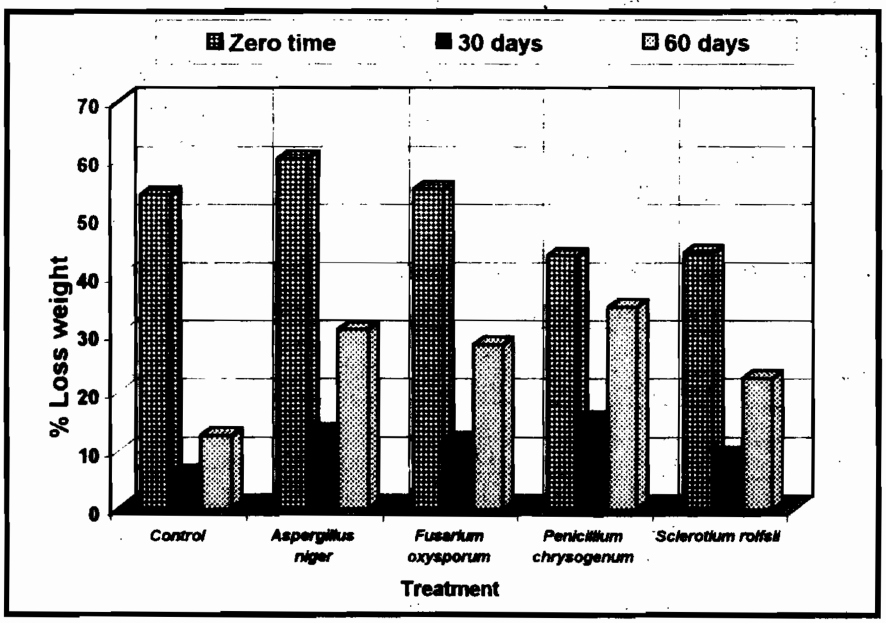

Fig. (2): Effect of artificial inoculation of garlic bulbs by *A. niger, F. oxysporum, P. chrysogenum* and *S. rolfsii* on % loss in bulb after 0, 30 and 60 days of storage.

- Effect of storage temperature and packing materials on % loss in bulb weight through storage:

__Temperature:__ Results of this experiment are shown in Table (3). There were gradual losses in bulb weights through storage period at all degrees of temperature used. The minimum loss was observed at 5°C while, the highest was at 40°C at both tested periods. The percentages of depleted cloves were mostly followed by % loss in bulbs weight. The great loss observed in bulbs stored at 40°C was probably due to water loss and draught rather than due to infection, since at this degree, depleted cloves which produced pathogens was very low and being 0.0, 3.33%, while the highest was at 10 and 20°C through the two periods, (Table 3). Temperature ranged from 20-25 °C assumed to be most convenient for growth and sporulation of the four virulent fungi. Through *Penicillium* and *Aspergillus* were also grew well at 10-15 °C. These results reflected the occurrence of depletion phenomenon under storage indoor at room temperature. The garlic bulbs stored at 10-15 °C showed also depletion symptoms and the deterioration at this range of temperature was slower than that occurred at room temperature, in particular when bulbs were infested with more than one fungus before harvesting. The temperature favour depletion was comparable to that for growth.

Table (3): Effect of storage temperature on percentage of loss in fresh weight of garlic bulbs and depleted cloves.

Temp. °C	Loss in wt. after		Depleted cloves* after:	
	3 months**	6 months	3 months	6 months
5	1.71	3.84	6.67	13.33
10	6.87	17.54	16.67	43.33
20	5.74	11.030	13.33	23.33
30	9.03	21.27	10.00	16.67
40	19.71	48.32	3.33	0.00

*** Which produced fungi after isolation procedures.**
**** From harvesting.**

Though degree of 5 °C or below assumed to be unfavourable. Studies carried out by Folchi and Mari (1984) proved that, infection with *Aspergillus* sp., *Fusarium* sp. and *Penicillium* sp. was more marked and severe at 25 and 30 °C. Ragab *et al.* (1984) found that, the optimum temperature for rot development of *F. solani* in garlic cloves, cv. Balady was 25 °C where considerable loss in samples, weight through storage was observed.

Packing materials: The lowest percentages of loss were recorded in case of use plastic net for storage, being 6.68 and 10.02% after 3 and 6 months storage respectively. Whereas the highest loss in bulb weight was in plastic package, being 29.13% and 43.07% after 3 and 6 months storage respectively. Storage in holed plastic showed also high loss in bulb weight, being 24.77 and 36.35% after the two periods of storage respectively (Table 4). These findings are in agreement with those of El-Shabrawy *et al.* (1981) who found that, a plastic package either holed or net was not convenient for bulb packing during storage and caused considerable loss in bulb weight. Probably this finding might be due to less ventilation and accumulation of high humidity, which favour fungal development and sprouting. The latter caused considerable biochemical changes including high level of soluble sugars and decrease in phenols, condition, which perfectly favours fungal development within clove tissues. On the other hand, plastic net packages were much more suitable and keep well ventilated conditions.

Table (4): Effect of packing materials on % loss of garlic bulbs after 3 and 6 month* storage at room temperature, 25-30°C.

Packing materials	Loss in fresh weight after *	
	3 months	6 months
Plastic package	29.13	43.07
Holed plastic package	24.77	36.35
Paper package	7.75	16.73
Plastic net package	6.68	10.02

*** From harvesting.**

- Effect of NPK levels under field conditions:

Results of this study are shown on Tables (5-10). These were significant differences between the control, without NPK, and the other treatments along the storage periods and for both tested seasons (2000/2001 and 2001/2002). The lowest percentages of loss in bulbs, being 17.25 and 17.65 after six months storage were obtained for bulbs produced from plants fertilized in 2000/2001 with the two levels $N_2P_2K_3$ and $N_2P_2K_2$, respectively followed directly by $N_2P_1K_2$ and $N_2P_3K_3$ where the percentages of loss were 19.09 and 19.81 for the two treatments, respectively as compared with the control, 48.50%, after six months storage at room temperature. There was gradual increase in weight loss with prolonged storage periods. In the same season. 2000/2001, there were no loss in weight in some levels ($N_1P_1K_1$, $N_1P_2K_2$, $N_1P_2K_3$, $N_1P_3K_2$, $N_1P_3K_3$, $N_2P_1K_1$, $N_2P_1K_2$, $N_2P_2K_2$, $N_2P_2K_3$, $N_2P_3K_2$ and $N_3P_1K_2$), after one month storage, these probably healthy bulbs and became infected through transportation and/or through storage (Table 5). The results of season 2001/2002, are shown in Table (6), were mostly much the same as for 2000/2001 at room temperature 25-30°C.

Storage at 10-12°C caused higher loss in weight than those stored at room temperature during 2000/2001 and 2001/2002 growing seasons (Tables 6-9). The percentages of loss after six months storage ranged from 24.74 to 41.67. The lowest being at the level of $N_3P_2K_3$, where the highest was due to fertilizer with $N_2P_3K_1$ (Table 7). In season 2001/2002, the percentages of loss in weight of bulbs stored at 10-12°C ranged from 25.26% to 42.86% due to using $N_3P_2K_3$ and $N_3P_2K_1$ fertilizers, respectively. Whereas in the control, the loss in bulb weight ranged from 48.41 to 50.86 for 2000/2001 and 2001/2002 seasons respectively (Tables 7 and 8).

The lowest percentages of depleted cloves after six months storage at room temperature, season 2000/2001 and 2001/2002 ranged from 22.5 to 25.0% for both seasons due to using $N_2P_2K_2$ and $N_2P_2K_3$ levels of fertilizers which included balanced value and/or with higher ratio of potassium (Table 8).

Adding fertilizers caused reduction of onion white rot disease and accompanied with yield increasing. This finding was obtained when fertilizers were added at the rate of 400 kg nitrogen, 400 kg phosphorus and 100 kg potassium per feddan (Sirry *et al.*, 1969). Also, El-Shabrawy *et al.* (1981) stated that increasing level of ammonium nitrate to garlic up to 1200 kg/feddan during the growing season of garlic increased the infection to 4.2 and 4.7 times in two successive seasons. The infection with *F. oxysporum*, *P. citrinum* and *B. allii* was stimulated to a greater extent than that of other pathogens by increasing of N levels. Also, the same authors added that the infection was decreased to 50% when super phosphate was added at the rate of 800 kg/feddan, which was favourable to *Fusarium* infection. Infection was decreased to 33% by increasing rate of potassium sulfate to 200 kg/feddan.

In case of storage at 10-12°C, the results were much the same as storage at room temperature. In season 2000/2001 the range of depleted cloves, was 32.5% to 45.0%, the lowest value was recorded when used $N_2P_3K_2$ level; while the highest was due to treatment with $N_1P_1K_1$ (very low ratios). Wile, in season 2001/2002 the range of depleted cloves was 27.5% (for $N_2P_3K_3$) to 45% (for $N_2P_2K_1$). The former treatment contained higher amount of both phosphorous and potassium while the later contained lower amounts of both elements (Tables 9 and 10). So, phosphorus and potassium have been claimed in many diseases, to be responsible for plant resistance against certain pathogens. The mechanism by which both elements effect is interpreted by strengthen of cell wall and tissues resulted in a source of mechanical resistance. Formation of P- and K- compounds, in cell protoplasts, including enzymes and their coenzymes are not ignored to make the cell well functioned, Koltunov (1984).

Table (5): Effect of NPK levels on the percentage of loss in fresh weight of garlic bulbs during 6 months of storage at room temperature in 2000/2001.

No.	Treatment			Storage period (month) and loss%					
	N	P	K*	1	2	3	4	5	6
1	N_1	P_1	K_1	0.00	6.41	12.82	17.95	23.08	25.64
2	N_1	P_1	K_2	1.54	7.69	13.85	20.00	23.07	23.07
3	N_1	P_1	K_3	2.22	6.67	11.11	15.56	18.52	22.22
4	N_1	P_2	K_1	2.35	8.24	12.94	17.65	21.18	23.53
5	N_1	P_2	K_2	0.00	3.90	12.99	18.18	20.13	20.13
6	N_1	P_2	K_3	0.00	6.25	12.50	17.50	21.25	23.75
7	N_1	P_3	K_1	3.33	8.89	13.33	16.67	18.89	24.44
8	N_1	P_3	K_2	0.00	7.23	12.25	18.07	21.69	24.10
9	N_1	P_3	K_3	0.00	4.29	10.00	14.29	18.57	21.43
10	N_2	P_1	K_1	0.00	7.69	12.31	16.92	20.00	23.08
11	N_2	P_1	K_2	0.00	3.64	9.09	14.55	18.18	19.09
12	N_2	P_1	K_3	2.44	6.10	9.76	14.63	17.07	17.68
13	N_2	P_2	K_1	2.33	8.14	13.37	18.60	22.09	24.42
14	N_2	P_2	K_2	0.00	4.71	8.23	11.76	15.29	17.65
15	N_2	P_2	K_3	0.00	3.09	8.02	11.73	13.58	17.25
16	N_2	P_3	K_1	1.43	7.14	13.57	20.00	25.71	28.57
17	N_2	P_3	K_2	0.00	4.12	9.41	12.35	15.29	18.82
18	N_2	P_3	K_3	0.94	4.72	8.96	13.68	16.98	19.81
19	N_3	P_1	K_1	1.27	7.59	14.56	19.62	26.58	31.65
20	N_3	P_1	K_2	0.00	2.86	7.14	13.97	18.57	21.43
21	N_3	P_1	K_3	0.61	3.66	9.76	15.24	19.51	25.61
22	N_3	P_2	K_1	3.33	6.67	10.56	16.11	20.56	26.11
23	N_3	P_2	K_2	0.50	3.98	9.95	15.42	21.39	23.88
24	N_3	P_2	K_3	0.53	4.21	7.37	11.05	15.26	20.00
25	N_3	P_3	K_1	2.53	8.23	12.66	17.09	21.52	24.68
26	N_3	P_3	K_2	2.96	7.88	11.82	16.25	22.16	25.12
27	N_3	P_3	K_3	2.23	6.70	12.85	15.64	20.67	24.02
28	Without NPK			4.95	9.90	19.80	29.70	39.60	48.51
L.S.D. for months at 5%				2.49	5.89	5.29	5.62	5.23	5.87

* per feddan N_1= 200 kg P_1= 250 kg K_1= 62.5 kg
N_1= 400 kg P_1= 500 kg K_1= 125 kg
N_1= 600 kg P_1= 750 kg K_1= 187.5 kg

Table (6): Effect of NPK levels on the percentage of loss in fresh weight of garlic bulbs during 6 months of storage at room temperature in 2001/2002.

No.	Treatment			Storage period (month) and loss%					
	N	P	K	1	2	3	4	5	6
1	N_1	P_1	K_1	0.00	7.14	14.29	20.00	25.71	28.86
2	N_1	P_1	K_2	1.33	8.00	14.67	20.00	25.33	26.67
3	N_1	P_1	K_3	0.00	7.25	13.77	21.74	26.09	26.09
4	N_1	P_2	K_1	1.30	8.44	14.29	22.08	24.68	25.32
5	N_1	P_2	K_2	1.88	7.50	13.75	18.75	22.50	25.63
6	N_1	P_2	K_3	0.00	5.88	12.35	18.24	21.76	23.53
7	N_1	P_3	K_1	2.44	8.54	14.63	19.51	24.39	26.83
8	N_1	P_3	K_2	1.97	7.89	13.82	20.39	23.68	23.68
9	N_1	P_3	K_3	0.00	6.88	12.50	16.88	21.88	25.00
10	N_2	P_1	K_1	0.00	6.33	12.66	17.72	20.25	24.05
11	N_2	P_1	K_2	2.22	6.67	11.67	15.56	19.44	22.22
12	N_2	P_1	K_3	4.64	10.67	16.00	21.33	25.33	25.33
13	N_2	P_2	K_1	2.41	8.34	13.25	18.07	21.69	24.10
14	N_2	P_2	K_2	1.05	6.32	11.05	15.79	18.95	21.05
15	N_2	P_2	K_3	0.00	6.88	12.50	16.25	20.00	20.00
16	N_2	P_3	K_1	0.00	5.77	10.90	14.74	18.59	20.51
17	N_2	P_3	K_2	1.32	7.24	15.13	22.37	26.32	27.63
18	N_2	P_3	K_3	2.22	7.78	13.33	18.89	23.33	23.89
19	N_3	P_1	K_1	0.25	10.00	16.25	22.50	28.75	31.25
20	N_3	P_1	K_2	0.00	6.47	11.76	17.64	25.88	28.24
21	N_3	P_1	K_3	0.00	7.69	15.38	18.46	23.08	23.08
22	N_3	P_2	K_1	0.00	4.29	10.00	14.29	17.14	20.00
23	N_3	P_2	K_2	2.74	9.59	15.07	19.18	23.29	26.03
24	N_3	P_2	K_3	0.00	4.48	9.70	13.43	16.42	17.91
25	N_3	P_3	K_1	1.90	5.71	12.38	15.24	20.95	23.81
26	N_3	P_3	K_2	1.67	6.67	11.67	16.67	21.67	25.83
27	N_3	P_3	K_3	1.53	6.63	12.24	18.37	22.45	23.47
28	Without NPK			5.26	15.79	28.42	41.05	43.16	45.26
L.S.D. for months at 5%				2.88	3.711	4.87	6.79	6.09	6.37

Table (7): Effect of NPK levels on the percentage of loss in fresh weight of garlic bulbs during 6 months of storage at 10-12 °C in 2000/2001.

No.	Treatment			Storage period (month) and loss%					
	N	P	K	1	2	3	4	5	6
1	N_1	P_1	K_1	2.78	9.72	16.67	23.61	31.94	39.58
2	N_1	P_1	K_2	6.15	14.62	20.00	26.15	30.77	38.46
3	N_1	P_1	K_3	4.00	9.33	11.33	21.33	28.00	36.00
4	N_1	P_2	K_1	4.38	11.25	18.13	25.00	30.00	34.38
5	N_1	P_2	K_2	4.62	10.77	16.15	21.54	26.15	30.77
6	N_1	P_2	K_3	4.52	11.04	16.13	22.58	27.10	30.32
7	N_1	P_3	K_1	3.57	10.71	17.14	22.86	27.88	33.57
8	N_1	P_3	K_2	2.60	9.09	16.88	19.48	29.87	33.77
9	N_1	P_3	K_3	2.52	11.32	18.87	25.16	29.56	31.45
10	N_2	P_1	K_1	5.22	13.43	19.40	25.37	29.85	32.84
11	N_2	P_1	K_2	3.64	10.30	16.97	23.64	27.88	29.70
12	N_2	P_1	K_3	3.23	9.77	16.77	23.87	26.45	27.74
13	N_2	P_2	K_1	3.95	11.18	19.74	25.00	28.95	30.26
14	N_2	P_2	K_2	2.78	8.33	13.33	18.33	24.44	26.66
15	N_2	P_2	K_3	3.13	7.50	13.75	18.75	22.50	25.00
16	N_2	P_3	K_1	3.21	12.82	22.44	30.77	38.46	41.67
17	N_2	P_3	K_2	3.49	11.63	19.19	25.00	31.98	34.30
18	N_2	P_3	K_3	3.41	10.23	18.75	27.84	34.09	35.80
19	N_3	P_1	K_1	5.45	14.55	15.45	31.82	39.09	40.91
20	N_3	P_1	K_2	8.82	15.29	22.35	27.65	32.94	35.29
21	N_3	P_1	K_3	3.45	11.03	20.00	25.52	31.03	33.79
22	N_3	P_2	K_1	3.08	15.38	23.08	30.77	40.00	41.54
23	N_3	P_2	K_2	4.76	13.49	23.81	30.95	37.30	39.68
24	N_3	P_2	K_3	3.16	7.89	12.63	16.32	20.00	24.74
25	N_3	P_3	K_1	4.71	11.76	20.59	29.41	35.29	41.18
26	N_3	P_3	K_2	2.65	10.60	19.21	23.18	28.48	35.10
27	N_3	P_3	K_3	4.00	11.50	19.00	26.00	31.50	36.50
28	Without NPK			4.76	12.70	22.22	32.54	40.48	48.41
L.S.D. for months at 5%				2.83	5.24	4.04	4.51	5.96	4.99

Table (8): Effect of NPK levels on the percentage of loss in fresh weight of garlic bulbs during 6 months of storage at 10-12 °C in 2001/2002.

No.	Treatment			Storage period (month) and loss%					
	N	P	K	1	2	3	4	5	6
1	N_1	P_1	K_1	1.33	9.33	18.67	26.67	35.33	41.33
2	N_1	P_1	K_2	1.40	13.89	23.61	30.56	37.50	37.50
3	N_1	P_1	K_3	2.90	11.59	18.84	27.56	33.33	36.23
4	N_1	P_2	K_1	2.50	11.25	18.75	26.25	32.50	35.62
5	N_1	P_2	K_2	1.32	10.53	19.74	26.31	30.26	32.89
6	N_1	P_2	K_3	1.33	6.67	17.33	26.67	30.00	32.00
7	N_1	P_3	K_1	2.67	10.67	16.00	22.67	28.00	33.33
8	N_1	P_3	K_2	2.99	13.43	21.64	28.35	32.84	35.07
9	N_1	P_3	K_3	3.53	10.59	21.18	29.41	36.47	40.00
10	N_2	P_1	K_1	2.22	7.78	13.89	21.11	26.11	30.56
11	N_2	P_1	K_2	0.00	8.57	15.71	23.57	30.00	32.86
12	N_2	P_1	K_3	3.05	7.93	15.85	22.56	29.27	31.10
13	N_2	P_2	K_1	2.50	10.00	18.13	25.00	30.63	33.75
14	N_2	P_2	K_2	1.67	8.33	15.00	22.22	27.78	30.56
15	N_2	P_2	K_3	3.05	11.59	17.07	21.95	26.82	29.27
16	N_2	P_3	K_1	2.56	10.26	17.31	25.00	34.62	41.03
17	N_2	P_3	K_2	3.61	10.84	19.28	27.71	32.53	34.94
18	N_2	P_3	K_3	1.73	8.09	16.18	24.86	27.17	30.64
19	N_3	P_1	K_1	3.33	10.83	20.00	28.33	37.50	41.67
20	N_3	P_1	K_2	3.23	10.97	18.71	24.52	29.68	32.90
21	N_3	P_1	K_3	3.80	11.39	18.99	26.58	31.65	31.65
22	N_3	P_2	K_1	3.97	15.87	25.40	33.33	39.68	42.86
23	N_3	P_2	K_2	1.53	9.23	16.92	24.62	30.77	35.38
24	N_3	P_2	K_3	2.63	10.00	15.79	21.05	23.16	25.26
25	N_3	P_3	K_1	2.74	11.64	19.86	26.71	34.25	39.73
26	N_3	P_3	K_2	3.39	11.86	19.49	25.42	28.81	32.20
27	N_3	P_3	K_3	3.41	11.93	13.64	23.86	30.11	34.09
28	Without NPK			4.31	17.24	25.00	34.48	43.10	50.86
L.S.D. for months at 5%				2.42	5.27	6.26	5.35	4.79	4.58

Table (9): Effect of NPK fertilization levels on the percentage of depleted* cloves of bulbs during stored at room temperature for 6 months.

No.	Treatment			Storage period (month) and loss%					
				2000/2001			2001/2002		
	N	P	K	2 M.	4 M.	6 M.	2 M.	4 M.	6 M.
1	N_1	P_1	K_1	5.00	20.00	32.50	2.50	17.50	35.00
2	N_1	P_1	K_2	0.00	22.50	30.00	5.00	25.00	32.50
3	N_1	P_1	K_3	2.50	27.50	30.00	0.00	22.50	30.00
4	N_1	P_2	K_1	7.50	20.00	35.00	0.00	25.00	37.50
5	N_1	P_2	K_2	0.00	20.00	27.50	7.50	17.50	30.00
6	N_1	P_2	K_3	2.50	17.50	30.00	0.00	20.00	32.50
7	N_1	P_3	K_1	0.00	20.00	32.50	0.00	20.00	35.00
8	N_1	P_3	K_2	0.00	17.50	32.50	5.00	15.00	30.00
9	N_1	P_3	K_3	0.00	17.50	30.00	7.50	17.50	27.50
10	N_2	P_1	K_1	2.50	25.00	37.50	2.50	25.00	35.00
11	N_2	P_1	K_2	0.00	15.00	30.00	5.00	17.50	32.50
12	N_2	P_1	K_3	0.00	20.50	35.00	2.50	22.50	37.50
13	N_2	P_2	K_1	0.00	17.50	25.00	0.00	20.00	32.50
14	N_2	P_2	K_2	0.00	12.50	22.50	0.00	15.00	25.00
15	N_2	P_2	K_3	2.50	20.00	25.00	0.00	17.50	22.50
16	N_2	P_3	K_1	0.00	20.00	27.50	2.50	22.50	32.50
17	N_2	P_3	K_2	2.50	15.00	25.00	0.00	20.00	27.50
18	N_2	P_3	K_3	0.00	12.50	22.50	0.00	15.00	27.50
19	N_3	P_1	K_1	5.00	17.50	37.50	5.00	15.00	35.00
20	N_3	P_1	K_2	5.00	22.50	35.00	7.50	20.00	37.50
21	N_3	P_1	K_3	0.00	25.00	32.50	2.50	22.50	35.00
22	N_3	P_2	K_1	2.50	22.50	40.00	2.50	25.00	42.50
23	N_3	P_2	K_2	0.00	22.50	37.50	0.00	17.50	37.50
24	N_3	P_2	K_3	0.00	25.00	32.50	0.00	20.00	35.00
25	N_3	P_3	K_1	0.00	20.00	40.00	2.50	20.00	45.00
26	N_3	P_3	K_2	7.50	22.50	35.00	5.00	17.50	37.50
27	N_3	P_3	K_3	2.50	22.50	42.50	5.00	15.00	47.50
28	Without NPK			10.00	32.50	55.00	12.50	37.50	57.50

*** which produced fungi after isolation procedures.**

Table (10): Effect of NPK fertilization levels on the percentage of depleted* cloves of bulbs during stored at 10-12 °C for 6 months.

No.	Treatment			Storage period (month) and loss%					
				2000/2001			2001/2002		
	N	P	K	2 M.	4 M.	6 M.	2 M.	4 M.	6 M.
1	N_1	P_1	K_1	5.00	27.50	45.00	2.50	22.50	40.00
2	N_1	P_1	K_2	5.00	25.00	42.50	5.00	27.50	40.00
3	N_1	P_1	K_3	2.50	27.50	42.50	5.00	25.00	37.50
4	N_1	P_2	K_1	5.00	25.00	45.00	7.50	27.50	42.50
5	N_1	P_2	K_2	2.50	22.50	40.00	5.00	25.00	40.00
6	N_1	P_2	K_3	0.00	25.00	37.50	2.50	22.50	40.00
7	N_1	P_3	K_1	7.50	27.50	40.00	5.00	30.00	42.50
8	N_1	P_3	K_2	2.50	25.00	37.50	0.00	22.50	37.50
9	N_1	P_3	K_3	2.50	22.50	35.00	0.00	20.00	40.00
10	N_2	P_1	K_1	5.00	27.50	42.50	5.00	25.00	45.00
11	N_2	P_1	K_2	5.00	25.00	37.50	2.50	27.50	42.50
12	N_2	P_1	K_3	2.50	22.50	35.00	0.00	22.50	37.50
13	N_2	P_2	K_1	7.50	27.50	40.00	2.50	30.00	45.00
14	N_2	P_2	K_2	0.00	20.00	30.00	2.50	17.50	32.50
15	N_2	P_2	K_3	0.00	27.50	30.00	0.00	20.00	30.00
16	N_2	P_3	K_1	7.50	27.50	37.50	2.50	27.50	35.00
17	N_2	P_3	K_2	0.00	20.00	32.50	5.00	17.50	30.00
18	N_2	P_3	K_3	0.00	20.00	30.00	0.00	17.50	27.50
19	N_3	P_1	K_1	7.50	27.50	37.50	7.50	25.00	35.00
20	N_3	P_1	K_2	5.00	25.00	40.00	7.50	22.50	32.50
21	N_3	P_1	K_3	5.00	22.50	40.00	5.00	20.00	35.00
22	N_3	P_2	K_1	7.50	30.00	42.50	5.00	25.00	40.00
23	N_3	P_2	K_2	2.50	27.50	35.00	2.50	25.00	30.00
24	N_3	P_2	K_3	2.50	22.50	37.50	7.50	22.50	32.50
25	N_3	P_3	K_1	5.00	25.00	40.00	5.00	27.50	37.50
26	N_3	P_3	K_2	2.50	25.00	37.50	2.50	20.00	40.00
27	N_3	P_3	K_3	0.00	22.50	35.00	5.00	25.00	40.00
28	Without NPK			12.50	24.50	62.50	15.00	45.00	67.50

*** which produced fungi after isolation procedures.**

- Effect of growth regulators, under field conditions on garlic bulbs depletion during storage:

This experiment was carried out for two successive seasons, 2000/2001, 2001/2002. The results of both experiments are almost the same in particular when the bulbs were stored at room temperature (25-30°C). In 2000/2001 and at the later degree, the lowest loss in bulb weight, being 10% was recorded in case of use Cicocel, 100ppm after four-months storage. Also, the same treatment caused the lowest loss, 13.81% after six months storage. While the highest loss, 26.67% was observed in bulbs produced from plants sprayed with 100ppm Somart after 6 months storage. For the same season, 2000/2001, the range of loss in weight was 13.81-26.67% as compared with 38.55% in the control at room temperature (Table 11). Whereas, the range of loss in 2001/2002 was 11.9% to 27.59% after six months storage as compared with 43.33% in the control under the same conditions of storage (Table 11).

In case of storage at 10-12°C the highest loss in bulb weight after 4 and 6 months storage were 25.37 and 32.84 respectively by using 100 ppm Somart at season 2000/2001. The same treatment caused the highest loss for season 2001/2002. The lowest loss for both seasons was in bulbs produced from plants sprayed with Gibbrelic acid at 50 ppm.

After six months storage, the range of loss was 12.5 to 32.84%, for season 2000/2001, compared with 56.67% for the control. After one-month storage at 10-12°C, the loss in weight was 0.0% for all treatments in the two seasons. Similar results were obtained at room temperature in case of use 50 ppm Gibbrelic acid; 100 ppm Cicocel, 25 and 50 ppm Somart; for season 2000/2001 and the results were almost the same in season 2001/2002 (Tables 12).

Table (11): Effect of spraying garlic plants with some growth regulators on the average percentage of loss in bulbs fresh weight during 6 months of storage at room temperature (25-30°C) in 2000/2001 and 2001/2002.

Treatment	Dose	Loss % during 2000/2001 season						Loss % during 2001/2002 season					
		Storage period (month)						Storage period (month)					
		1	2	3	4	5	6	1	2	3	4	5	6
Gibberelic acid	50 ppm	0.00	3.91	9.09	13.03	14.34	15.65	0.00	4.76	13.16	15.79	15.79	17.64
	100 ppm	0.10	6.00	11.50	16.50	18.50	21.50	0.00	5.26	17.64	19.04	19.04	21.22
	200 ppm	0.59	7.64	14.12	18.82	22.35	24.70	1.80	8.82	19.04	22.23	23.53	23.53
Cicocel	100 ppm	0.00	2.86	6.67	10.00	12.38	13.81	0.00	5.90	9.41	11.76	11.76	11.90
	200 ppm	0.57	5.17	9.77	13.21	16.67	18.96	2.30	8.04	11.70	13.79	13.77	19.54
	300 ppm	1.30	9.09	15.58	18.18	20.78	22.08	2.99	14.92	21.64	22.38	25.37	25.37
Somart	25 ppm	0.00	3.64	8.24	11.76	13.53	19.41	0.00	4.76	14.29	14.29	16.67	16.67
	50 ppm	0.00	4.37	9.38	12.50	16.25	22.50	0.00	5.17	13.79	19.54	19.54	20.22
	100 ppm	0.67	3.33	11.33	18.00	21.33	26.67	3.57	10.34	22.22	24.14	27.59	27.59
Control		3.61	10.24	18.67	24.70	31.93	38.55	7.14	11.43	26.73	28.57	40.00	43.33
LSD for months at 5% level		1.82	5.42	5.74	5.74	5.97	4.81	0.00	4.39	4.68	5.24	4.92	5.06

Table (12): Effect of spraying garlic plants with some growth regulators on the average percentage of loss in bulbs fresh weight during 6 months of storage at 10-12°C in 2000/2001 and 2001/2002.

Treatment	Dose	Loss % during 2000/2001 season						Loss % during 2001/2002 season					
		Storage period (month)						Storage period (month)					
		1	2	3	4	5	6	1	2	3	4	5	6
Gibberelic acid	50 ppm	0.00	2.50	5.00	7.50	11.00	12.50	0.00	2.00	5.60	8.40	11.20	14.80
	100 ppm	0.00	5.80	8.82	11.76	17.64	23.50	0.00	3.40	6.31	12.14	17.48	23.30
	200 ppm	0.00	8.70	17.39	21.73	21.73	26.08	0.00	4.52	10.55	16.58	23.62	28.64
Cicocel	100 ppm	0.00	6.25	13.19	16.67	20.14	22.22	0.00	2.72	5.91	10.45	14.09	19.54
	200 ppm	0.00	9.09	15.58	18.83	22.07	25.32	0.00	3.08	6.67	13.33	17.94	23.08
	300 ppm	0.00	12.50	20.00	22.50	25.00	30.00	0.00	10.37	17.68	18.90	23.78	28.05
Somart	25 ppm	0.00	4.76	16.67	19.50	23.81	21.41	0.00	2.17	5.98	12.50	15.22	19.57
	50 ppm	0.00	5.88	17.65	20.59	26.47	26.67	0.00	3.49	6.98	13.37	19.77	25.58
	100 ppm	0.00	17.91	21.64	25.37	29.10	32.84	0.00	4.38	8.75	19.38	21.25	31.25
Control		0.00	17.39	28.57	40.00	43.33	56.67	0.00	12.11	20.53	27.37	35.79	43.16
LSD for months at 5% level		0.00	5.08	5.91	3.96	5.30	5.42	0.00	5.11	5.33	5.45	4.98	5.07

Percentages of depleted cloves were estimated in random samples of the stored bulbs and the results are shown in Tables (13 and 14). The range of depleted cloves after four months storage was 2.5% to 12.5% at season 2000/2001. The lowest value was due to spraying garlic plants with 50 ppm Gibbrelic acid while the highest value was due to spraying with 50 ppm Somart compared with 27.5% in the control. The same results were obtained at season 2001/2002. After six months storage at room temperature, the lowest percentages of depletion at seasons 2000/2001 and 2001/2002 were 15% and 17.5% respectively and due to spraying garlic plants with 100 ppm Cicocel, compared with the control (42.5% and 47.5%) respectively. When the bulbs stored at 10-12°C, the results exhibited slight difference. The percentages of depleted cloves for season 2000/2001 ranged from 17.5 to 50%, compared with 95% in the control. Whereas for season 2001/2002 the range was fluctuated between 20% and 42.5% compared with 87.5% in the control (Table 13). These results are probably due to one or more of the following: (a) the direct effect, probably retardation of infection and development of the pathogens responsible for depletion. (b) retardation or possibly prevention of clove sprouting. The latter phenomenon is well known to cause numerous biochemical changes within clove tissues, among these are increase in soluble sugars and decrease in diallyle disulphide and phenol compounds. These changes are known to favour fungal development within clove tissues and any factor interrupt or retard these biochemical changes are certainly lead to retard or prevent fungal development and subsequently reduce clove demaciation or depletion, (Elian *et al.*, 1990). Omar and Arafa (1979) decleared that garlic plants sprayed with malic hydrazide two weeks before harvesting caused noticeable reduction of sprouting through 300 days storage. Similar results were found by Hilman and Asandhi (1987), De-La-Rosa Ibarna *et al.* (1994), Rahim *et al.* (1994), Selvaraj *et al.* (1995) and Barman *et al.* (1996).

Table (13): Effect of growth regulators on the percentage of depleted* garlic cloves stored at room temperature for six months.

Treatment	Dose	% depleted cloves during storage period (month)					
		2000/2001			2001/2002		
		2 months	4 months	6 months	2 months	4 months	6 months
Gibbrelic acid	50 ppm	0.00	2.50	32.50	0.00	10.00	27.50
	100 ppm	0.00	5.00	27.50	2.50	2.50	17.50
	200 ppm	2.50	5.00	17.50	0.00	5.00	22.50
Cicocel	100 ppm	0.00	10.00	15.00	0.00	5.00	17.50
	200 ppm	2.50	5.00	27.50	5.00	5.00	20.00
	300 ppm	2.50	2.50	22.50	2.50	7.50	20.00
Somart	25 ppm	2.50	5.00	25.00	5.00	10.00	22.50
	50 ppm	5.00	12.50	27.50	2.50	12.50	25.00
	100 ppm	5.00	7.50	22.50	2.50	15.00	22.50
Control		10	27.50	42.50	12.50	32.50	47.50

* Which produced fungi after isolation procedures.

Table (14): Effect of growth regulators on the percentage of depleted* garlic cloves stored at 10-12°C for six months.

Treatment	Dose	% depleted cloves during storage period (month)					
		2000/2001			2001/2002		
		2 months	4 months	6 months	2 months	4 months	6 months
Gibbrelic acid	50 ppm	0.00	12.50	22.50	2.50	15.00	25.00
	100 ppm	0.00	5.00	17.50	2.50	10.00	20.00
	200 ppm	2.50	7.50	20.50	0.00	7.50	20.00
Cicocel	100 ppm	0.00	12.50	32.50	0.00	10.00	27.50
	200 ppm	0.00	10.00	27.50	0.00	12.00	30.00
	300 ppm	2.5	17.50	35.00	7.50	20.00	37.50
Somart	25 ppm	2.5	15.00	30.00	2.50	17.50	32.50
	50 ppm	2.5	17.50	37.50	7.50	17.50	35.00
	100 ppm	7.50	27.50	50.00	10.00	22.50	42.50
Control		10.00	60.00	95.00	12.50	65.00	87.50

* Which produced fungi after isolation procedures.

REFERENCES

Abd El-Megid, M.S. (1994). Studies on some soil borne fungi affecting garlic plants in ARE. Ph.D. Thesis Fac. of Agric., Suez Canal Univ., Egypt.

Abdel-Al, H.R.; Baraka, M.A.; El-Tobshy, Z.M. and Boghdady, M.M. (1991). Integrated control of postharvest garlic rot diseases. Egypt. J. of Agric. Res., 69: 723-734.

Barakat, F.M.; Kararah, M.A.; Mikhail, M.S. and Fouly. H.M. (1985). Role of three species of bacteria in decaying garlic bulbs. Egypt. J. of Phytopathol., 17: 115-129.

Barman, D.; Shrma, L.C. De' C.K. and Sing, I.P. (1996). Effect of growth regulators on garlic (*Allium sativum* L.). Ann. of Plant Physiol., 10(2): 210-215.

Bottcher. H. and Pohle, K. (1991). Studies of the occurrence of postharvest decay of garlic bulbs (*Allium sativum* L.). Archiv-fur-Phytopathologie-und-Pflanzenschutz. 27 (6): 445-457.

Barnett, H.L. (1972). Illustrated Genera of Imperfect Fungi. Dept. of Plant Pathol., Bacteriol and Entomol. West Virginia Univ., Morgan Taiwan Burgess Publish Company.

Booth, C. (1971). The Genus *Fusarium*. Commonwealth Mycological Instit., Kew Surrey, England, 237pp.

Brwon, W. (1924). Two mycelial methods of isolating single strains of fungi by cutting out a hyphal tip. Ann. Bot., 38: 402-402.

De-La-Rosa-Ibarna-M.; Mat, R.K.; Oan-B-de; B. De-Leon nad Rosa-Ibarram-dela (1994). Effect of Gibbrelic acis and 2,4-D on the yield of garlic phyton. Buenos-Aires, 56: 91-94.

Elian, M.I.; Eisa, H.A.; El-Deeb, A.A. and Metwally, A.H. (1990). Evaluate the effect of spray three growth regulators on garlic demaciation in storage. Zagazig J. Agric. Res., 17(2): 301-312.

El-Shabrawy, A.M.; Amein, A.M. and Sallam, A. (1981). Resistance of garlic cultivars to certain storage disease in relation to their chemical composition. Assiut J. of Agric. Sci., 12 (2): 137-143, 1981.

Folchi, A. and Mari, M. (1984). The effect of temperature on sprouting and infection of garlic in storage. Rivista della ortoflorofrutticoltura taliana, 68(4): 317-322.

Hilman, Y. and Asandhi, A.A. (1987). Effect of several kinds of foliar fertilizers and plant growth regulator on the growth and yield of garlic C.V. Lumbu Hija in the rainy season. Bulletin Penelitian Hortikuitura 151: 267-272.

Kararah, M.A. and El-Tobshy, Zeinab (1979 a). Preliminary observation on the effect of certain pathogenic organisms on garlic depletion phenomenon. Proc. 3rd. Egypt. Phytopathol. Cong., 419-443.

Kararah, M.A. and El-Tobshy, Zeinab (1979 b). Colves rot garlic caused by *Aspergillus niger* Van Tiegham in Egypt. Proc. 3rd. Egypt. Phytopathol. Cong., 444-454.

Keitt, G.W. (1915). Single techniques for isolating single spore strains of certain types of fungi. Phytopathology, 5: 266-269.

Koltunov, V.A. (1984). Effect of different fertilizer rates on garlic productivity and storability. Visnik Sil's' Kogospodars' koi-Nauki, 11: 52-54.

Martinez, M. and Granda, Y. (1993). A garlic bulb and its phytopathological limitations as seed in the country PONAAP-Divulga, 10,44, 17-18.

Omar, F.A. and Arafa, A.E. (1979). Effect of foliar spray with maleichydrazide (MH) on yield and keeping quality of garlic bulbs during storage. Agric. Res. Rev. Hortic., 57(3): 215-221.

Pinto, C.M.F. and Maffia, L.A. (1995). Diseases caused by fungi on garlic. In forme-Agropecu-ario-Belo-Horizonte. 17: 183, 5-11.

Radwan, L.A.M. (1980). Studies on storage diseases of garlic in the A.R.E. Ph.D. Thesis, Fac. Agric., Zagazig Univ.

Ragab, M.M.; Kararah, M.A.;

Osman, M.E. and Mostafa, M.A. (1984). Effect of infection with *Fusarium solani* on garlic cloves with special reference to the biochemical changes. Egypt. J of Phytopathol., 16 (1-2): 23-33.

Rahim, M.A.; Fordham, R. and Midmore, D.J. (1994). Control of bulbing in garlic. International symposium on alliums for the tropics. Bangkok Thailand, 15-19 Feb. 1993. Acta Hortic., 1994 No. 358: 369-374.

Ramirez, C. (1982). Manual and Atlas of Pinicillia. Elsevier Biomedica. New York and Oxford. 874pp.

Rath, G.C. and Mohanty, G.N. (1986). Fusarium rot of stored garlic. Indian Phytopathol., 39 (4): 614-615.

Samson, R.A. and Pitt, J.I. (1990). Modern Concepts in *Penicillium* and *Aspergillus* Classification. Plenum Press, New York and London, 478pp.

Satour, M.M (1960). Index of Plant Diseases in United States. Crops Res. Div., United States Dept. Agric., Hand Book No. 165, Washington D.C.

Selvaraj, N.; Irviappan, I. And Vedamuthu, P.B. (1995). Effect of growth regulators on yield of garlic (*Allium sativum*). South Indian Hortic., 43pp. 18-20.

Singh, K.; Jens, C.F.; Ulf, T. and Mathur, S.B. (1991). An Illustrated Manual Identification of Some Seed-borne *Aspergilli*, *Fusarium* and *Penicillia* and their Mycotoxins. Danish Government Instit. of Seed Pathol. for Developing Countries. Denmark. 132pp.

Sirry, A.R.; Ashour, W.A. and Elewa, I.S. (1969). Studies on some factors affecting the fungus *Sclerotium cepivorum* Berk causing white rot of onion. Res. Bull. 135, Fac. Agric., Ain Shams Univ.

Yoo, K.S.; Anderson, C.R. and Pike, L.M. (1989). Determinationof postharvest losses and storage life of "Texas Grano 1015Y" onion. J. Rio-Grande Valley Hortic. Soc., 42: 45-50.

تفريغ فصوص الثوم والفقد فى الوزن وعلاقته بالفطريات وبعض العوامل الأخرى أثناء التخزين

شعبـــان على خـــالـــد مدحـــت سعد عبـــد المجيـــد
صابـــر محـــمد مرســـى عزة عبد الرافع شرف الدين
معهد بحوث أمراض النباتات – مركز البحوث الزراعية – الجيزة – مصر

أجريت الدراسة على تأثير بعض الفطريات والعوامل الأخرى مثل (درجات الحرارة المختلفة وعبوات التعبئة والتركيزات المختلفة للتسميد المتكامل NPK ومنظمات النمو) على الفقد والتفريغ لفصوص الثوم فى المخزن. كان فطر *Aspergillus niger* أكثر الفطريات تكرارا بين الفطريات المعزولة من فصوص الثوم والتى بها ظاهرة التفريغ ، وأظهر أنه أهم هذه الفطريات تأثيرا فى إحداث التفريغ والفقد فى الوزن. وجد أن تخزين رؤوس الثوم على درجة ٥ °م أعطت أقل فقد فى المحصول وأقل نسبة للتفريغ أما التخزين على درجة ٤٠ °م أعطت أعلى فقد فى وزن المحصول وأقل نسبة للتفريغ خلال ٣ إلى ٦ أشهر إلى ٣% ، صفر% على التوالى. كما أثبتت الدراسة أن التخزين فى عبوات البلاستيك كانت أقل عبوات التخزين المستخدمة فقداً فى وزن المحصول مقارنة بالعبوات الأخرى. وأيضا وجد أن التسميد بمعدل مرتفع من البوتاسيوم والفوسفور أعطى أقل فقد فى وزن الرؤوس وأيضا اقل فى التفريغ. وقد أعطى إستخدام حمض الجبريليك والسيكوسيل رشا على نباتات الثوم افضل النتائج فى التخزين وقد أدى استخدام حمض الجبريليك إلى إنخفاض الفقد فى الوزن بعد التخزين.