International Journal of ChemTech Research
CODEN (USA): IJCRGG ISSN: 0974-4290
Vol.8, No.12 pp 121-129, 2015

Adenine and Guanine application and its Effect on Salinity tolerant of Wheat plants and Pest infestations

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Abstract: For study the response of wheat plants to the nitrogen basics treatments and salinity, a pot experiment was conducted in the greenhouse of the National Research Center in the winter season of the 2010 / 2011. Wheat plants irrigated by 4000 ppm diluted seawater and tap water as a control and sprayed by 150 ppm of guanine (Gu) and adenine (Ad). The control plants were sprayed by the same quantity of distilled water. A negative relationship could be shown between vegetative growth characters i.e. plant height, number of green leaves and area of green leaves. Moreover, stem, leaves, spikes and whole plant dry weight were similarly responded. Irrigation wheat plants with salt solution (4000 ppm) decreased these characters compared to that of plants irrigated with fresh water, respectively. Growth, fresh and dry weight of plants markedly decreased with salinity**.** The results showed that the aphids infections were significantly decreased in Ad and Gu treatments in wheat pots.
Keywords: Wheat (*Triticum aestavum* L**)-**Salinity-Adenine-Guanine uanine- Growth-Chlorophyll-Carotenoids *Rhopalosiphum padi*, *Rhopalosiphum maidi*, *Sitobion avenae* aphids.

Introduction

Wheat (*Triticum aestivum L.*) is one of the most important growing crops in the world and in Egypt. The increases in its production and area did not face the increasing demand of the increasing in population. Although, wheat production per unit area have significantly increased during the past decades. Now a day the self about 57 % only and the rest were imported from abroad and still the expansion and increased the productivity are needs essentially. The challenges of this aim are the problems of lake of water resources, poverty of nutrients and raises of salinity in the new reclaimed and cultivated areas.

Soil salinity is a wide spread problem around the world but generally affected arid and semiarid regions. It is largely being increased in irrigated lands due to poor drainage, irrigation practices low rain fall and high transpiration rate [1]. Also the use of saline water as a condensation of the lack in fresh water to face the water needs of the target areas.

Abiotic stresses severely reduced the productivity of the almost crops including wheat [2-9] as other plants.

Recently plants treated with bio-regulators and antioxidants in order to alleviate the biotic and abiotic stresses [7-10], Salt stress influences accumulation of mineral nutrients in cereals . Wheat is susceptible to various kinds of pests that feed on the underground and aboveground parts of the plant including roots, stems, leaves and ears. Among the sap sucking arthropods, aphids are the most widely distributed group. Aphids cause direct damage by feeding deeply within the leaf whorl and inject a toxin in the plant which destroy the chloroplast membrane and indirect damage by transmission of several plant viruses (barley yellow dwarf Luteo virus) and by developing molds on their honey dews. BYDV-PAV is spread worldwide and its most significant transmitter is the aphid [11-18]. The aphid infestations significant affect wheat cultivars {12,13,14]. Host plant resistance is an important part of IPM for aphids [15, 17,18]. This work aims at determining the suitable wheat cultivar as well as the suitable sown dates to manage aphids infesting wheat at Qalyubiya ecosystem.

Cereal aphids have been found infesting wheat plants in Egypt [19,20].*Rhopalosiphum padi (L.), Rhopalosiphum maidis* (Fitch), consider the more serious pests on the cereal, causing a destructions to wheat and many other crops [21-25]**.**

Guanine was active at a low concentration of 8×10^{-12} M/cm^2 of filter paper. Guanine was shown to induce assembly in *Amblyomma cohaerens* Donitz larvae and *Rhipicephalus appendiculatus* Neumann adults [26] . Adenine [(*S*)-DHPA] causes female sterility in certain insects. This has been associated with an inhibition of hydrolase in the ovaries [27]. They also mentioned that, the ovarian SAH-hydrolase, isolated by affinity chromatography, is inhibited by (*S*)-DHPA and some other open-chain analogues of adenosine. The most pronounced *in vitro* inhibition of the ovarian SAH-hydrolase has been achieved with deritadenine, which is also the most potent chemosterilant. he assembly behaviour of the tick*Argas persicus* Oken in response to guanine has been found to be humidity dependent. Nymphal and adult male *A. persicus* assemble on guanine-treated paper disks only at low relative humidity (25 ± 5%). Exposure of the ticks to high relative humilities (85 ± 5%) results in a gradual induction of a negative response to the pheromone [28]. Therefore, the objective of this work is to evaluate the effect of guanine and adenine spraying and salt stress on growth, photosynthetic pigments and post infestations of wheat plants.

Materials and Methods

For study the response of wheat plants to the nitrogen basics treatments and salinity, a pot experiment was conducted in the greenhouse of the National Research Center in the winter season of the 2010 / 2011. Wheat plants irrigated by 4000 ppm diluted seawater and tap water as a control and sprayed by 150 ppm of guanine and adenine. The control plants were sprayed by the same quantity of distilled water.

Wheat (*Triticum aestavium L.*) Were sown at Dec., 3.The treatments of the experiment 8 which was the combination of two salinity treatment and spraying treatments of guanine and adenine in complete blocks design in six replicates. Calcium super phosphate (15.5% P2O5) and potassium sulphate (48.5% K2O) were added to the soil in the rate of 3.0 and 1.5 g/pot were broadcasted on the soil surface before sowing.

Ammonium sulphate (20.5 % N) were added to the soil in the rate of 1.5 g/pot in two equal portion, the first have was at three weeks and the second have was two weeks later. The treatments of guinene and adenine and distilled water treatments were applied at 21 and 35 days from sowing.

Photosynthetic pigments were determined according to the methods described by [22] All collected Data were subjected to the proper statistical analysis as described by [22]. The aphids *R. padi* and *R. maidis* were reared under laboratory conditions according to [19].

Aphids Population Density counting:

Regularly weekly interval excursions were made to this experimental region for two successive seasons, from 13th of January 2011 to 5th of May 2011 for the first season, and from 15th of January 2012 to 6th of May 2012 for the second season.. For recording the aphid's population density ten wheat plants were randomly selected from each cultivar replicate (30 plants/ cultivar). Population density of different aphid species was determined by counting all individuals of each aphid species per plant on leaves, stem and in later stage also on spike using 10x lenses in the field**.**

Identification of different aphids on wheat:

Wheat aphid species which collected during this experimental period were brought to the laboratory for identification. Mounted microscopic slides of for different aphid species a late form were prepared. Available taxonomic keys were used to identify different collected aphid species according to [15].

Susceptibility of aphids *R. padi* and *R. maidis* to fungi under laboratory conditions.

The fungi *B.b; M.a; V.l, N.r,P.f* at the concentrations 1X 10^7; 1X 10^6; 1X 10^5; 1X 10^4 ;1X 10^3 and 1X 10^2 spores/ml were tested against *R. padi* and *R. maidis* **.** Bioassay techniques according to [23]. The percentage of mortality determined and corrected according [29] and LC_{50} calculated according [30]. The experiments were replicated 4 times.

Field trials:

The field trials were carried out during two wheat successive seasons (2013-2014) at Eben-Malek farm at El –Nobaryia region (N. R. C), to study the effectiveness of the fungi tested on *R. padi* and *R. maidis* in the wheat fields. Wheat plant (Variety Giza 164) were cultivated at mid-November during two wheat successive seasons in area half of fedan of tested formulations were then applied as single treatment in randomize plots. All cultures treatments were made as in free province. Regular agricultural practices were normally performed and no chemical control was used during the study period, weeds were removed by hand. Five plots were treated by water as control

Four plots were treated by water as control. Samples of the titter were collected weekly, transferred to laboratory for investigations. The percentages of mortality were calculated and the infestations of, *R. padi* and *R. maidis* were estimated.

Results and Discussion

Growth

Effect of salinity

A negative relationship could be shown between vegetative growth characters i.e. plant height, number of green leaves and area of green leaves. Moreover, stem, leaves, spikes and whole plant dry weight were similarly responded. Irrigation wheat plants with salt solution (4000 ppm) decreased these characters compared to that of plants irrigated with fresh water, respectively (Table 1). Growth like fresh and dry weight of plants markedly decreased with salinity. It is well established fact that plants growing under salinity condition remain stunted due to the reduction in cell elongation, cell enlargement and cell division, which are under the control of different auxins, whose is synthesis is retarded [31, 32,33, 34, 35].

Table (1): Response of wheat plants growth to salinity and nitrogen basics.

Salinity	NB	Plant height	Number of Leaves	Area of leaves cm	Dry weight			
					Stem	Leaves	spikes	Total
TW	DW	63.2	3.3	82.9	0.43	0.62	0.33	1.38
	Ad	73.2	5.0	143.4	0.58	0.77	0.36	1.71
	Gu	74.3	5.0	155.0	1.02	0.69	0.46	2.17
Mean		70.2	4.4	127.1	0.68	0.69	0.38	1.75
4000	DW	53.7	3.7	75.6	0.31	o.59	0.28	1.18
	Ad	65.3	4.7	111.0	0.63	0.60	0.31	1.54
	Gu	65.8	4.0	88.1	0.75	0.63	0.31	1.69
Mean		61.6	4.1	91.6	0.56	0.61	0.30	1.47
Mean Values	DW	58.5	3.5	79.3	0.37	0.61	0.31	1.28
	Ad	69.3	4.9	127.2	0.61	0.69	0.34	1.63
	Gu	70.1	4.5	121.5	0.89	0.66	0.39	1.93
LSD at 5%	S	N.S	0.14	N.S	0.09	N.S	N.S	N.S
	NB	2.55	N.S.	5.57	0.25	N.S	N.S	0.41
	SxNB	N.S	N.S	N.S	0.36	N.S	N.S	N.S

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Effect of guanine and adenine

It is clear from Table 1 Data that spraying adenine and guanine increased all growth parameters. These increases more pronounced in area of leaves and stem dry weight (Table 1). [33,34, 35] concluded that adenine improved growth and yield of corn [36] studies the relation of adenine and respiration.**[35]** reported that ATP concentration was increased by adenine, the ADP was not affected while guanine and uracil gave slight effect but cytozine was not affect on ATP. Adenine addition did not affect respiration which confirmed the result of [37]. [38] mentioned that adenine converted to adenine monophosphate in plant tissues (AMP). This why adenine treatment play a role in improve whole growth and indicating a link between purine and stress acclimation.

Salinity x Adenine and guanine

Spraying nitrogen basic and salinity condition interaction effect on growth of wheat plants was presented in Table (1). Plant height and stem and top dry weight increased by ammonium basic under saline condition or fresh water. Both nitrogen basic induced the same effect on plant height. Spraying adenine and guanine increased area of leaves by 72.98 and 86.97 % when plants received fresh water and by 46.83 and 16.54 % when plants grown under soil condition, respectively.

Table (2): Response of photosynthetic pigments of wheat plants to salinity and nitrogen basics.

Salinity	NB	Chl.a	Chl.b	Carot.	Chl.a+Chl.b	Chl.a:Chl.b	Chl.a+Chl.b: Carotenoids
Tw	**DW**	6.93	4.49	3.08	11.42	1.54	3.71
	Ad	6.78	3.67	2.97	10.45	1.84	3.52
	Gu	8.74	3.22	3.49	11.96	2.71	3.43
Mean		**7.48**	**3.79**	**3.18**	**11.28**	**2.03**	**3.55**
4000	**DW**	5.30	7.33	2.67	12.73	0.74	4.77
	Ad	5.99	3.34	1.70	8.64	1.56	5.08
	Gu	5.56	3.39	1.55	9.33	1.79	6.02
Mean		**5.56**	**4.67**	**1.97**	**10.23**	**1.36**	**5.29**
Mean NB	**DW**	6.71	5.91	2.88	12.08	1.04	4.19
	Ad	6.04	3.51	2.34	9.55	1.72	4.08
	Gu	7.37	3.28	2.29	10.65	2.25	4.65
LSD at 5%	**S**	**N.S**	**N.S**	**1.28**	**N.S**	**.....**	**……**
	NB	**N.S**	**2.31**	**0.89**	**1.49**	**……..**	**.....**
	SxNB	**N.S**	**N.S**	**1.69**	**2.11**	**……**	**……..**

Table 3 . Response of wheat plants after salinity and nitrogen basics against insect pests infestations under laboratory conditions

Salinity		% of infestations		
		Rhopalosiphum padi	*Rhopalosiphum maidis*	*Sitobion avenae*
4000	DW	19	28	17
	Ad	24	25	25
	Gu	33	38	27
TW	DW	24	21	19
	Ad	29	37	29
	Gu	35	38	29
F –test	12.4			
LSD at 5%	11.8			

Table 3 show that the infestations of three wheat aphids responding to salinity and nitrogenous basis under laboratory conditions. Data show that , the percentage of different *R. padi*, *R. maidis* and *S. avenae* recorded 19, 28 and 17% after 400 salinity at distilled water DW treatments. The corresponding percentage of infestations after AD recorded 24, 25 and 25% ,. After guanine GU treatments the percentage of infestations with these aphids recorded 33, 38 and 27%. when the salinity recorded Tap water (TW), the infestations percentage recorded 2, 21 and 19%with (DW). The infestation recorded 29, 37 and29% with (Ad). Also it give 35, 38 and 29% with (Gu) for the three insect pest, *R. padi*, *R. maidis* and *S. avenae*, respectively (Table3).

Table 4 . Response of wheat plants after salinity and nitrogen basics against insect pests infestations under semifield conditions

Salinity		*% of infestations*		
		Rhopalosiphum padi	*Rhopalosiphum maidis*	*Sitobion avenae*
4000	DW	16	18	10
	Ad	14	15	15
	Gu	13	18	17
TW	DW	28	11	22
	Ad	18	17	19
	Gu	11	18	18
F –test	12.4			
LSD at 5%	11.8			

Table 4, shows that under green house (semifield conditions), the percentages of infestation recoded at 400 salinity which irrigated with DW 16 18 and 10 for *R. padi*, *R. maidis* and *S. avenae* , respectively. The infestations percentages significantly decreased when wheat irrigated with TW 11, 18, and 18% for *R. padi* , *R. maidis* and *S. avenae*, respectively (Table 4). Figure 1 show that the infestations with aphides were significantly decreased when irrigated with Dw and Ad or Gu. The same results obtained by [39-48] who control the wheat aphides with biological control agents. The same findings obtained by [49-55].

Fig. 1: The infestations of differen aphids espices under semi field conditions after nitrogen basices on salinity

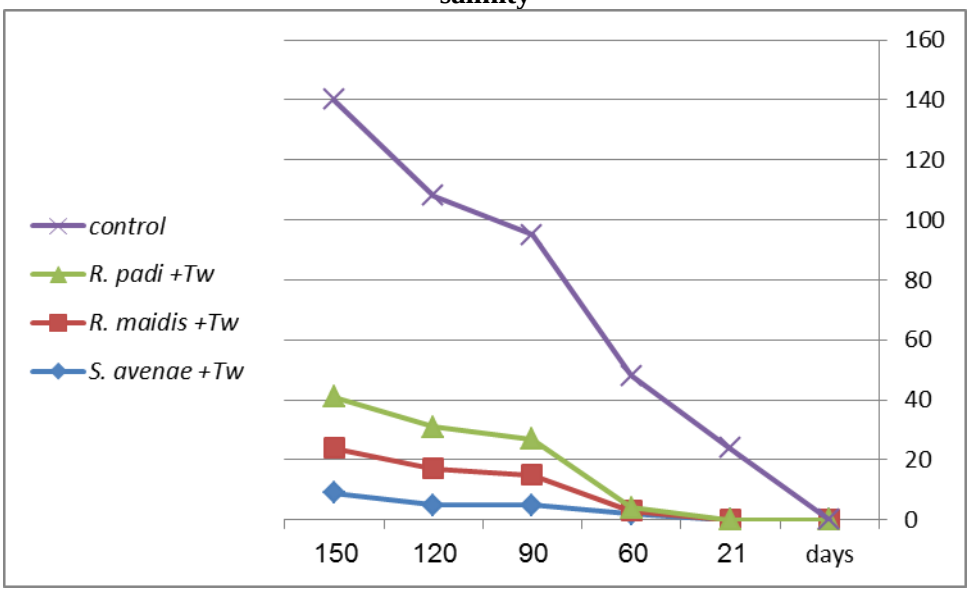

Figure 1 show that the three aphids species infestations were significantly decreased after nitrogen basics on salinity tolerant in wheat fields as compared in the control.

Photosynthetic pigments

Effect of salinity

Data in Table (2) reported that chl.a increased by guanine however, carotenoids concentration seemed to be without effect. On reverse, chl.b and total chl. decreased with both basic compare to plants received distilled water. In addition, Chl.a;chl.b ratio raised pronouncly but chl.a + chl.b: carotenoids ratio slightly increased. Chlorophyll is a membrane pound and depends upon the membrane stability flux under saline condition it seldom remains intact [33]. Decrease in chlorophyll contents due to salinity has been also reported elsewhere [34,35] .However, others recorded the increases in chlorophyll content as subjection to salinity. Accordingly, different workers gave different reasons for increase or decrease in chlorophyll content due to salinity. However, researchers summarized by showing that reduction in chlorophyll my be due to variation in its synthesis between the plant species due to the variation in specific enzymes. Another feature was the shift in Chl.a\b ratio which showed that reduction was more severe than chl.a and this affected this ration. This finding confirmed by [33].

Effect of guanine and adenine

Data in Table (2) indicated the increases in chl.a and chl.a:chl.b or chl.a+chl.b:carotenoids ratios were detected by ammonium basics. Nevertheless, chl.b, carotenoids and total chl. concentration were decreased by these nitrogen compounds. [56,57,58] studied the effect of benzyl adenine on chlorophyll content. [56,57] found that benzyl adenine increased chla and total chlorophyll and carotenoids, chlorophyll index, carotenoids and total pigments.

Salinity x Adenine and guanine

The interactive effect of guanine or adenine and salinity on photosynthetic pigments was illustrated in Table (2). Chl.b decreased with nitrogen basic so plants irrigated by Saline or fresh water. However, chl.a increased in plants irrigated by fresh water but not affecter under saline water irrigation. Adenine spraying decreased carotene under fresh or saline water but guanine decreased carotenoids or total chl. concentration under saline water only. Moreover, chl. a:chl. b ratio increased also with the two irrigation treatments but

chl.a+chl.b: carotenoids ratio increased under saline conditions. [33] demonstrated that adenine treatment increased growth and yield of wheat and improved the tolerance of plants to moisture stress. [59] used the benzyl adenine in increase vase life of rose red one.

References:

1. Munns, R. and H.M. Rawson. 1999. Effect of salinity on salt accumulation and reproductive development in the apical meristem of wheat and barley. Aust. J. Plant Physiol. 26:459–464.
2. Gao, J.B.;Dia-Yin, C. and Lin, H.X. (207). Understanding abiotic response tolerance mechanism. Recent studies in rice *J. integrate*. Plant Biol., 49:742-750.
3. Shabaan.; M.M.; Hussein, M.M. and A.M. El-Saady (2008). Nutritional status in shoots of barley genotypes as affected by salinity of irrigation water. *American J. of Plant Physiol., 3(2): 89 – 95.*
4. Shaaban, M.M.; Hussein, M.M. and El-Saady A.A. (2010). Growth of sugar beet as affected by diluted sea irrigation water and possible enhancement of salinity stress tolerance with MPK foliar fertilization. *Fruit, Vegetable and Cereal Science and Biotechnology, 4(1 Special issue):88-92.*
5. Hussein, M.M. and Sabbour, M.M.2014. Irrigation intervals and nitrogen fertilizer on yield and water use efficacy of sorgum of fodder. International Journal of Science and Research (IJSR) ISSN (Online): (2014) . 404-410.
6. Hussein, M.M.; Youssef, R.A. and Nesreen H. Abo-Bakr (2014).Influences of potassium foliar fertilization and irrigation by diluted seawater on growth and some chemical constituents of cotton. IJSR, 3(11):3127-313.
7. Hussein, M.M.; Camilia El-Diewny, Y. and Tawfik, M.M. 2014b. Management strategy for improving growth and mineral status of Moringa grown under water stress conditions. Enviro. Treat. Tech., 2(4): 184-190.
8. Hussein, M.M.; Mehana, H.M.; Zaki, S. and Abd El-Hadi, N. 2014.Influences of salt-stress and foliar fertilizers on growth chlorophyll and carotenoids of jojoba plants. *Middle East Journal of Agric., 3(2):Research.221-226.*
9. Hussein, M. M. and N.F. Abd El Hady ,2014. Growth and Photosynthetic Pigments Responses of Durum Wheat Varieties to Irrigation by Diluted Sea Water. *International Journal of Science and Research (IJSR), 3(12):1656-166*
10. Sabok, M.; Abd El-Hamid and Mostafa, H. 2013. Alleviation of adverse effects of salt stress in wheat cultivars by foliar treatment wiuth antioxidants I-Changes in growth, some biochemical aspects and yield quality and quantity. American Eurasian J Agric.& Environ. Sci., 13(11): 1476-1487.
11. Kieckhefer, R.w, , N.C. Elliott, W.E. Riedell and B.W. Fuller. 1994. Yield of spring wheat in relation to level of infestation by greenbugs (HOMOPTERA: APHIDIDAE). The Canadian Entomologist / Volume 126 / Issue 01 / February, 61-66.
12. Louis S. Hesler, Walter E. Riedell, Robert W. Kieckhefer, and Scott D. Haley. 2002. Responses of Rhopalosiphum padi (Homoptera: Aphididae) on Cereal Aphid-Resistant Wheat Accessions1. J. Agric. Urban Entomol. 19(3): 133–140.
13. Savaris.M., S Lampert, J R Salvadori, D Lau, , P R V S Pereira, M A Smaniotto, 2013. . Population Growth and Damage Caused by *Rhopalosiphum padi* (L.) (Hemiptera, Aphididae) on Different Cultivars and Phenological Stages of Wheat. Neotropical Entomology .October 2013, Volume 42, Issue 5, pp 539-543.
14. Aslam, M, Razaq M., Akhter , W., Faheem , M. & Ahmad , F. 2005. Effect of sown date of wheat on aphid (*Schizaphis gramium Rondani*) population. Pak. Entomol. 27 (1): 79 2.
15. Blackman, R. L. , Eastop , V. F.2000. Aphids on the World's Crops:An Identification and Information Guide . Second Edition. John Wiley & Sons, England. 466 pp.
16. Bosque Perez, N. A. & Schotzko, D. J. 2000. Wheat genotype, early plant growth stage and In festation density effects on Russian wheat aphid (Homoptera:Aphididae) population increase and plant damage. J. Entomol. Sci. 35 (1): 22 -38.
17. Bukvayova, N., Henselova M., Vajcikova ,V. & Kormanova , T. 2006. Occurrence of dwarf virus of winter wheat and b arley in several regions of Slovakia during the growing seasons 2001 2004. Plant. Soil. Envir. 52 (9): 392 401.
18. Gair, R., Jenkins, J. E. E. & Lester , E. 1987. Wheat pest. pp. 32 -65. In Cereal Pest & diseases (fourth Edition) Farming Press Ltd U.K. p.268

19. Gill, C. C. 1980.Assessment of losses on spring wheat naturally infected with barley yellow dwarf virus. Plant Dis. 64: 197 -203.
20. Abdel-Rahman, M. A. A. 1997. Biological and ecological studies on cereal aphids and their control in upper Egypt . *Ph. D. Thesis. Fac. Agric. Assiut Univ. 231pp.*
21. Abdel-Rahman, M. A. A. 2000. Incidence hymenopterous parasitoids attacking cereal aphids in wheat fields in Upper Egypt. Assiut. *J. Agric. Sci. 31: 317-328.*
22. Abdel-Rahman, M. A. A.; A. .Y. Abdel-Mallek; S. A. Omar and A. H. Hamam. 2004. Natural occurrence of entomopathogenic fungi on cereal aphids at Assiut A comparison study between field and laboratory observations. *Egypt. J. Boil. Sci. 14: 107-112.*
23. Abdel-Rahman, M. A. A. 2001. Seasonal prevalence of entomopathogenic fungi attacking cereal aphids infesting wheat in southern Egypt. Inter. Symposium. *Agric. Agadir-Morocco 7-10 Oct.2001: 381-389.*
24. Abdel-Rahman, M. A. A. and A. Y. Abdel-Mallek, 2001. Paramilitary records on entomopathogenic fungi attacking cereal aphids infesting wheat plants in southern Egypt. First Conference for safe Alternatives of pesticides for pest managements, Assiut *(Oct. 28-29 2001) : 183-190.*
25. Abdel-Rahman, M. A., A. Ahmedy; Y. Abdel-Mallek and G. H. A. Hmam, 2006. A comparative abundance of entomopathogenic fungi of cereal aphids in Assiut Egypt. *J. Boil. Pest cont. 16: 39-43.*
26. Dismas A. Otieno[a1], A. Hassanali[a1], F. D. Obenchain[a1], A. Sternberg[a2] and R. Galun[a] Identification of guanine as an assembly pheromone of ticks. International Journal of Tropical Insect Science / Volume 6 / Issue 06 / December 1985, pp 667-670.
27. Ivan Votruba,Antonín Holý, Ivan Rosenberg, and Karel Sláma, 2003. Inhibition of ovarian SAH-hydrolase in *Pyrrhocoris apterus*, sterilized with (*S*)-9-(2,3-dihydroxypropyl)adenine. Insect Biochemistry, Volume 15, Issue 5, Pages 631–634
28. Hassanali, A ., , E. Nyandat, , F. A. Obenchain, , D. A. Otieno and , R. Galun, 1989. Humidity effects on response of*Argas persicus* (Oken) to guanine, an assembly pheromone of ticks. Journal of Chemical Ecology , March 1989, Volume 15, Issue 3, pp 791-797
29. Abbott, W. S., 1925. A method of computing the effectiveness of an insecticide. *J. Econ. Entomol., 18: 265-267.*
30. Finney, D. J., 1964. Probit analysis. 2nd Ed., Cambridge. *Univ. Press. England. 318 PP.*
31. Balal, R.M.; Ashraf, M.Y.; Khan, M.M.; Jaskani, M.J. and Ashfaqi, A.m. 2011. Influence of salt stress on growth and biochemical parameters of citrus root stocks. Pak. J. of Bot., 43(4):2135-2141
32. Hussein; M.M.; Abd El-Khadr, A.A.; Kady, R.A.; Youssef, R.A. and A.K. Alva, 2010. Sorghum response to foliar application of phosphorus and potassium with saline water irrigation. Journal of Crop Improvement 24:1-13.
33. Hussein, M.M.; Abo lilla. B. H. ;Mohamed, S. and El-Liethy, S.. 2012. Effect of irrigation by salt water using Stroganov solution on anatomical structure of jatropha plants. Australian J. of Basic and Applied Sci. 8(1):491-496.
34. Hussein, M.M.; Tawfik, M.M.; El-saady, M.M.; Thalooth, A.T. and Mirvat E. Gobarah 2013,. Impact of foliar potassium application on growth, photosynthetic pigments and mineral content of castor bean plants grown under saline irrigation. *Scholar,s Electronic J. of Agron., 191): 1-9.*
35. Hussein, M.M., M.A. Ashoub and A.A. Khadr ,1980. Effect of adenine on growth and organic acids content of corn plants grown under different levels of soil moisture. Sci. social and Democraphic Res. March-April.Ain Shams Univ.Cairo, Egypt, 1980.
36. Allen, M.; Qin, W.; Moreau, F. and. Moffatt, B. 2002. Adenine phosphoribosy ltransferase isoforms of Arabidopsis and their potential contributions to adenine and cytokinin metabolism. Physiol. Plant., 115:. 56–68.
37. Bach, M.K. and Felling, J. 1960. Stimulation of the respiration of Chorellavulgaris by purine and purine analoges. Plant Physiol. Lancaster, 35, 36.
38. Suknong, S.; Yum, K.; Stadler, P.; Kumar, C.;Facciuolo, T.; Moffatt, B. and Facone, d. (2012). Improved Growth and Stress Tolerance in the Arabidopsis oxt1 Mutant Triggered by Altered Adenine Metabolism. Molecular Plant, 5, Issue 6:1310–1332.
39. Sahab, A.F. and Sabbour, M.M. 2011.Virulence of four entomo-pathogenic fungi on some cotton pests with especial reference to impact of some pesticides, nutritional and environmental factors on fungal growth. Egyp. J. Boil. Pest Cont., 21 (1): 61-67.
40. Sabbour, M.M. and Shadia E-Abd-El-Aziz , 2010. Efficacy of some bioinsecticides against *Bruchidius incarnatus* (BOH.) (Coleoptera: Bruchidae) Infestation during storage. J. Plant Prot. Res. 50, (1): 28-34.

41. Magda Sabbour and Shadia .E. Abed El-Aziz. 2002.Efficacy of some botanical oils formulated with microbial agents against the cotton leafworm and greasy cutworm attaching cotton plants. Bull. Ent. Soc. Egypt. ser. 28, 2001L2002: 135-151.
42. Sabbour, M.M and Shadia E-Abd-El-Aziz 2007. Efficiency of Some Bioinsecticides Against Broad Bean Beetle, *Bruchus rufimanus* (Coleoptera: Bruchidae). Res. J. of Agric. and Biol. Sci. 3(2): 67-72.
43. Sabbour, M.M and Shadia E-Abd-El-Aziz 2007. The effect of some bioinsecticides against *Callosobruchus maculates*. Bull. ent. Sco. Egypt. Vol. 11. 255-267.
44. Sabbour, M.M.; Shadia El-Sayed Abd-El-Aziz, Marwa Adel Sherief. (2012). Efficacy of three entomopathogenic fungi alone or in combination with diatomaceous earth modifications for the control of three pyralid moths in stored grain. J of. Plant Pro. Res.. Vol. 52, No. 3 :359-363.
45. Magda Mahmoud Sabbour and Shadia El-Sayed Abd-El-Aziz. 2014. Control of *Bruchidius incarnatus* and *Rhyzopertha Dominica* using two entomopathogenic fungi alone or in combination with modified diatomaceous earth. Elixir Entomology 68 (2014) 22239-22242.
46. Sabbour, M.M. and Shadia El-Sayed Abd-El-Aziz. 2015. Efficacy of some nano-diatomaceous earths against red flour beetle *Tribolium castaneum* and confused flour beetle, *Tribolium confusum* (Coleoptera: Tenebrionidae) under laboratory and store conditions. Bull. Env. Pharmacol. Life Sci., Vol 4 [7] June 2015: 54-59.
47. Sabbour M.M, Sahab AF. 2005. Efficacy of some microbial control agents against cabbage pests in Egypt. Pak. J. Biol. Sci.; 5(8): 1351-1356.
48. Sabbour MM, Sahab AF. Efficacy of some microbial control agents against *Agrotis ipsilon* and *Heliothis armigera* in Egypt. Bull. N.R.C. Egypt. 2007; 13(33): 165-174.
49. Sabbour M.M and S.M. Singer. 2015. Efficacy of Nano *Isaria fumosorosea* and *Metarhizium flavoviride* against Corn Pests under Laboratory and Field Conditions in Egypt. International Journal of Science and Research (IJSR). ISSN (Online): 2319-7064.
50. Sabbour M.M. and Singer, S.M. 2014. Efficacy of Two Entomopathogenic Fungi against Corn Pests Under Laboratory and Field Conditions in Egypt. European Journal of Academic Essays 1(9): 1-6, 2014.
51. Sabbour, M.M and Hussein, M.M. 2014. The singular and combined effects of entomopathogenic fungi *Beauveria brongniartii* and the insecticide imidaclorprid against corn pests under laboratory and field conditions in Egypt. (IJSR) Volume 3 Issue 10, October 2014. 2319-7064.
52. Sahab ,A.F; Sabbour , M.M.,Attallah,A.G. and Abou-Serreh, Nivin. 2014. Genetic analysis of the entomopathogenic fungus *Beauveria bassiana* to the corn borers tested by UV as physical mutagen. International Journal of ChemTech Research Vol.6, No.5, pp 2319-7064.
53. Sabbour M.M.and abdel-Rahman.2013. Efficacy of isolated *Nomuraea rileyi* and Spinosad against corn pests under laboratory and field conditions in Egypt Annual review and research in biology, 3(4): 903-912.
54. Sabbour, M.M., M. Ragei and A. Abd-El Rahman, 2011. Effect of Some Ecological Factors on The Growth of *Beauveria bassiana* and *Paecilomyces fumosoroseus* Against Corn Borers. Australian Journal of Basic and Applied Sciences, 5(11): 228-235, 2011.
55. Sabbour, Magda M, 2002.Evaluation studies of some bio-control agents against corn borers in Egypt. Annal Agric. Sci. Ain Shams Univ. Cairo, 47(3): 1033-1043.
56. Sordoei, A.S.; roien, A.; Shahdadi, F.; Sadeghi, T. and Mokhtari, T.S. (2014). Endogrnous gibberellic acid and benzyl adenine effect on stem elongation and leaf Schefflera arborecola L. plant. Intr. J. of Plant and animal and Environ. Sci., 4(3):431-437.
57. Sordoei, S .A.; Rahbarian, B. and Imani, F. (2014)a. Stimulatory effect of gibberrlic acid and benzyl adenine on growth and photosynthetic pigments of *Ficus benjamina* plabts. Intr. Adv. Biol. And Biomedical Res., 2(1)L 34- 42.
58. Sordoei, S. A.; Rahbarian, B.; Golamshahi, S; Shahdadenghad, M. 2014d. Evaluation estmate chlorophyll contents in three indoor ornamental plants with growth regulators. Intr. Europian J. of Exper. Biology, In press.
59. Gohlaml, M.; Rahemi, M. and Rastegar, S. 2011. Effect of plus treatment with sucrose, benzyl adenine and gebberellic acid on vase life of cut rose red one. Hort. Environ. Biotech, 52 (5): 482-487.

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