

Physiological studies on garlic crop

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The present study was conducted during two successive winter seasons of 2000-2001 and 2001-2002 at the Experimental farm of the Faculty of Agriculture Moshtohor, Zagazig University (Benha Branch) to investigate the effect of different organic manures source (Biogas, Compost and Farmyard manures), NPK fertilizers level and their mixtures as well as some micronutrients (Zn, Cu and Mn) application on growth characters, bulbs yield and its components as well as chemical composition and storageability of garlic bulbs (*Allium sativum* L.), cv. Chinese under loam soil conditions. The study included two field experiments as follows : First experiment : -This experiment was conducted to investigate the effect of NPK fertilizers level, different organic manure sources and their mixtures on growth characters, bulbs yield and its components as well as chemical composition and storageability of garlic plants. The results of this experiment could be summarized as follows : 1- Vegetative growth characteristics expressed as plant length, number of leaves /plant, fresh and dry weights of leaves as well as plant fresh weight were significantly increased when the plants were fertilized with chemical fertilizers as single or combined with organic manures containing 60 kg N /fed. in the same time the highest vegetative growth characters were obtained as a result of the application of 60 kg N + 32 kg P₂₀₅ + 48 kg K₂₀ plus biogas manure containing 60 kg N/feddan.2-Bulb characters i.e. bulb and neck diameter, bulb length and number of cloves/bulb were significantly affected with application of NPK fertilizers compared with the control treatment during both seasons of growth with the exception of number of cloves/bulb in the first season, which was not significantly affected. Moreover, the maximum increments in these characters were connected with higher used level of chemical fertilizers (120 kg N + 64 kg P₂₀₅ + 96 kg K₂₀ /fed.).3-The highest values of bulb characters were obtained as a result of using biogas manure; compost manure and farmyard manure every one at 60 kg N/ fed. plus mineral fertilizers contains 60 kg N + 32 kg P₂₀₅ + 48 kg K₂₀ /feddan for bulb diameter and length and number of cloves/bulb.4-No significant effect can be noticed between the studied treatments. However, the best results were obtained due to using biogas manure at 60 kg N/fed. plus 60 kg N + 32 kg P₂₀₅ + 48 kg K₂₀ /feddan at 180 days after planting during the first season of this study. 5- Total yield and its components differed significantly with different sources of organic manures during both seasons of this study. In this respect, application of different organic sources each at 60 kg N/fed. in combination with chemical fertilizers at rates of 60 kg N + 32 kg P₂₀₅ + 48 kg K₂₀ / fed. as organic sources reflected the maximum increments in total yield and its components compared with other treatments. Moreover, application of biogas manure plus 60 kg N + 32 kg P₂₀₅ + 48 kg K₂₀ gave the highest of total yield and its studied components i.e. clove weight, bulb fresh and dry weight as well as total fresh and cured yield t/fed.6- Chlorophyll a, chlorophyll b, total chlorophyll and total carotinoides were significantly increased with different organic manures sources, i.e. biogas, compost and farmyard manures compared with control. On the other hand photosynthetic pigments were significantly decreased with organic sources compared with treatments which received chemical fertilizers only up to 120 kg N + 64 kg P₂₀₅ + 96 kg K₂₀ /fed. or with combination between chemical fertilizers and organic sources. However, application of biogas manure + 60 kg N + 32kg P₂₀₅ + 48 kg K₂₀ gave the greatest values for photosynthetic pigments content in plant leaves during both seasons of this study.7-Total nitrogen, phosphorus and potassium contents of different plant parts, i.e. foliage and bulbs were significantly increased with increasing fertilizers in a form of chemical or as organic manures up to 120 kg N / feddan. The maximum values in this connect were

obtained with biogas, compost and farmyard manures respectively.8-NO₃ content of garlic bulbs was significantly increased with increasing N, P and K fertilizers level compared with other treatments. While application of 120 kg N + 60 kg P₂O₅ + 96 kg K₂O / fed. gave the highest values during both seasons of this trial. On the other hand, application of the used different organic sources containing 120 kg N/ fed. gave the lowest values of nitrate content in bulbs of garlic compared with mineral fertilizer treatments or those combined with organic fertilizers ones.9-The total carbohydrates percentage of different plant parts are improved with the mineral fertilizers during both seasons of this study. In this regard, 60 kg N + 32 kg P₂O₅ + 48 kg K₂O / fed. reflected the most increments in carbohydrates content of plant bulbs and application of 120 kg N + 64 kg P₂O₅ + 96 kg K₂O/ fed. gave the highest values of carbohydrate content of plant foliage.10-The carbohydrates percentage in both leaves and bulbs were significantly increased as a result of application of biogas, compost and farmyard manures each containing 120 kg N/fed. in a single or combined form over the control.11-The treatments which received organic sources i.e. biogas, compost or farmyard manures containing 60 kg N/fed. plus 60 kg N + 32 kg P₂O₅ + 48 kg K₂O / fed. mineral fertilizers reflected the lowest values in respect of weight loss through the storage period while, the highest values were recorded with mineral treatments especially at 120 kg N + 64 kg P₂O₅ + 96 kg K₂O /fed.12-Dry matter percentage subsequent to storage period was significantly decreased with using mineral fertilizers at either the low level (60 kg N +32 kg P₂O₅ + 48 kg K₂O /fed.) or the high used one (120 kg N + 64 kg P₂O₅ + 96 kg K₂O /fed.) compared with control treatment during both seasons of this trial. Moreover, application of different organic manures either in single or in combined forms resulted in decreasing dry matter percentage in bulbs subsequent to storage periods compared with control treatment in both seasons of study. 13- Increasing the NPK fertilizers level up to 120 kg N + 64 kg P₂O₅ + 96 kg K₂O /fed. significantly increased NPK contents in bulbs of garlic subsequent to storage period (6 months). In this respect, N, P and K bulbs contents were at their highest values with higher used level (120 kg N + 64 kg P₂O₅ + 96 kg K₂O /fed.) of mineral fertilizers compared with the control or with other used level (60 kg N + 32 kg P₂O₅ + 48 kg K₂O/fed.), different organic manures each equivalent to 120 kg N/fed. either in single or in combined form gave a significant effect on NPK contents of bulbs compared with the control treatments or with most of the other ones during storage period. Moreover, application of biogas manure equivalent to 60 kg N/fed. plus low used level of mineral NPK fertilizers showed the highest values of NPK bulbs contents. Second experiment:-This experiment was conducted to investigate the effect of Zn, Cu, Mn and their mixtures as pre-sowing soaking cloves or foliage spray of plants on growth characters, bulbs yield and its components as well as chemical composition and storageability of garlic bulbs. The results of this experiment could be summarized as follows : 1. All vegetative growth characters were significantly increased with increasing the concentration of micronutrients solution that applied as pre-planting soaking cloves or as foliar spray of garlic plants. Meanwhile, the highest values of aforementioned were obtained as a result to soaking cloves in solution of micronutrients combination at (800 + 600 + 400 ppm) for Zn, Mn and Cu. respectively, or foliar spray micronutrients combination at (600 + 400 + 200 ppm) for Zn, Mn and Cu respectively, compared with other treatments during both seasons of study.2. All bulb characters, which expressed as diameter for both of neck and bulb as well as bulb length and number of cloves / bulb were significantly increased with increasing micronutrients concentration during both seasons of study compared with the control. With foliar spray, highest values of bulb diameter was obtained by 600 ppm Zn + 400 ppm Mn + 200 ppm Cu during both seasons whereas the highest value of bulb length was obtained as a results of soaking cloves in 800 Zn + 600 Mn + 400 Cu. However, the maximum, increments of neck diameter were recorded by the control treatments in both seasons of study. In the same time, the lowest value of nick diameter was obtained with the highest used concentration of Zn, Mn and Cu. (Zn 800 + Mn 600 + Cu 400 ppm).3. Bulbing ratio at 90, 120, 150 and 180 days after planting did not show significant differences among the studied treatments i.e. pre-sowing soaking cloves and foliar application of some micronutrients However, the highest value of bulbing ratio at 90 days after planting was obtained by foliar application at 100 ppm Zn during both seasons of study. On the other hand, the control treatments give the greatest results in bulbing ratio at 180 days after planting during both seasons of growth.4.Total yield and its components were

significantly increased as a result of soaking the cloves or foliar spraying of garlic plants with any used micronutrients at its different used concentrations compared with the control treatment during both seasons of study. Moreover, pre-planting soaking cloves in solution contains 800 ppm Zn + 600 ppm Mn + 400 ppm Cu reflected the maximum increases in all studied characters during both seasons of growth except cloves weight in the first season. Meanwhile, Pre-planting soaking cloves in 400 ppm Cu gave the highest value of cloves weight.⁵ The micronutrients concentration of solutions used as pre-planting cloves soaking application or foliar spray on plants led to significant increases in chlorophyll a, b and total chlorophyll (a + b) as well as total carotinoides during both seasons of study compared with the control treatment. The maximum values of assayed photosynthetic pigments were connected with the highest used concentration as mixture of 800 ppm Zn + 600 ppm Mn + 400 ppm Cu. Or only 600 ppm Mn applied as pre-planting followed by the treatments which contain 400 ppm Zn + 300 ppm Mn + 200 ppm Cu used as foliar spray.⁶ NPK contents of plant foliage and bulbs were gradually increased with increasing the concentration of studied micronutrients. The highest values were obtained as a result of using micronutrients as soaking application at mixture rate (800 ppm Zn + 600 ppm Mn + 400 ppm Cu followed by foliar spray at (400 ppm Zn + 300 ppm Mn + 200 ppm Cu) Generally, soaking application gave the greatest NPK contents than foliar spray treatments during both seasons. ⁷ Zn, Mn and Cu contents in bulbs were significantly increased with increasing concentration of each micronutrient in solution during both seasons of this study. The highest values of Zn content was obtained as a result of using micronutrients as foliar application at 600 ppm Zn followed by Zn at 800 ppm as soaking application. Moreover, the highest values of Mn content was obtained as a result of using 300 ppm Zn + 200 ppm Mn + 100 ppm Cu as foliar spray followed by Mn at 600 ppm as soaking application. Generally, soaking application respected in higher values than foliar spray treatments during both seasons. ⁸ The carbohydrates percentages of different plant parts i.e. leaves and bulbs are increased with the highest concentrations of micronutrients as pre-sowing soaking cloves or foliar spraying of garlic plants during both seasons of this study. In the same, time the maximum consequences of carbohydrates were obtained due to application of (800 ppm Zn + 600 ppm Mn + 400 ppm Cu.) as foliar followed by (Zn at 400 ppm + Mn at 300 ppm + Cu at 200 ppm.) and Mn at 600 ppm. The differences between all pre-sowing soaking treatments were significant during both seasons of this study. On the other hand, total carbohydrates in leaves of garlic were significantly decreased with using the concentration of Zn at 300 ppm in the first season only comparing with control treatment. ⁹ All micronutrients treatments significant proved differences in values of weight loss through whole storage period (6 months) except in the second, third and sixth month, which had no significant effect compared with the control treatment during both seasons. Moreover, in the third and sixth months of storage, some concentration of micronutrients i.e. the low level (400 ppm Zn + 300 ppm Mn + Cu 200 ppm) and the high one (Zn at 800 ppm + Mn at 600 ppm + 400 ppm Cu) gave significant decreases in weight loss during the second season only.¹⁰ Dry matter content in bulbs after storage period was obtained as a result of the highest used concentration in both methods of application for the studied micronutrients in a mixture form i.e. Zn + Mn + Cu at 800, 600 400 in case of soaking and 600, 400 and 200 in case of spraying respectively, reflected the highest dry matter content compared with other tested treatment and or the control one. Such noticed increase in dry matter during storage may be due to attributed to the increase in moisture transpiration and consequently show such increase in dry matter. ¹¹ N, P and K contents in bulbs after storage were significantly increased with increasing the concentration of micronutrients that added as pre-sowing soaking cloves or foliar spray compared with control treatment. while the highest values for NPK content of bulbs were obtained due to combinations of Zn, Mn and Cu either at the higher used concentration (800 ppm Zn, 600 ppm Mn and 400 ppm Cu) or at the low one (400 ppm Zn, 300 ppm Mn and 200 ppm Cu).¹² Zn, Mn and Cu content in bulb after storage period (6 months) were significantly increased with increasing micronutrients concentrations in solution that used as pre-sowing soaking or with foliar spray compared with control treatment whereas application of Mn at 600-ppm improved Zn and Mn contents in garlic bulb in both seasons of study comparing with another treatments. However, application of Cu at 400 ppm gave the highest value in Cu contents in the first season. ¹³ Carbohydrates percentage in bulb after storage was

significantly increased with different concentrations of studied micronutrients, which applied as pre-sowing soaking cloves or with foliar spray. The greatest results, which gave the lowest loss in carbohydrates, were the combination between the used micronutrients at high or low concentrations during both seasons of study.