

Effect of some macro and micro-elements on yield and technological properties of wheat

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Two field experiments were carried out at the Agricultural Research and Experimental Station, Faculty of Agriculture Moshtohor, Zagazig University (Benha Branch), Kaluibia Governorate during 1999/ 2000 and 2000/ 2001 growing seasons. The present work aimed to study the effect of some macro and microelements on growth, yield and yield components as well as grain quality of wheat cultivar Gemmeiza 7. Each experiment included 32 treatments which were the combination of four levels of nitrogen (0, 40, 80 and 120 kg N/ fed.) two levels of phosphorus (0, 24 kg P2O5/ fed.) and four microelements treatments (0, ZnSO₄, MnSO₄, ZnSO₄ + MnSO₄ at 0.3 %). These treatments were arranged in split- split plot design with four replications in both seasons. The four levels of nitrogen were distributed at random in the main plots, two levels of phosphorus were arranged randomly in the sub plots and four treatments of microelements were assigned in the sub- sub plots. The area of each experimental plot was 10.5 m² (3.0 x 3.5 m) 1/400 feddan. Wheat variety Gemmeiza 7 was sown on 27 and 25 November in 1999/ 2000 and 2000/ 2001 seasons, respectively. The preceding crop was maize in both seasons. Wheat grains were drilled in rows at 20 cm apart at a rate of 60 kg/ feddan. Nitrogen fertilizer was applied in form of ammonium nitrate (33.5 N) and was divided in two equal portions, the first one just before the first irrigation and the second one before the second irrigation. Phosphorus fertilizer was applied before sowing in form of super phosphate (15.5 % P₂O₅). Zinc sulphate, manganese sulphate and their combined at 0.3 % were added as foliar spray after 45 days from sowing date. The spray volume was 400 liter/ feddan. Characters studied: I- Growth characters: 1-Plant height (cm) 2-Number of leaves/ plant 3-Fresh and dry weight of plants/ m² 4-Flag leaf area 5-Number of tillers/ m² 6-Number of spikes/ m² 11- Yield and yield components: 1-Spike characters (spike length, spike weight, grain weight/ spike and number of grains/ spike) 2-1000- grain weight 3-Grain yield (kg)/ feddan. 4-Biological yield (kg)/ feddan. III- Correlation coefficient: The association between grain yield and some characters of yield components of wheat. IV- Grain quality 1-Zn content (ppm). 2-Mn content (ppm). 3-N . 4-Protein content (%). 5-Protein yield (kg)/ feddan. The important results of this study could be summarized as follows: I- Growth characters: A- Effect of N levels : 1-The increase in N level from zero to 120 kg N/ feddan did not significantly induce any apparent increase in plant height, number of leaves/ plant and flag leaf area. 2-Fresh and dry weight of plants/ m², number of tillers and spikes/ m² significantly increased by increasing N level up to 120 kg N/ feddan in the combined analysis of the two growing seasons. whereas, no significant difference was obtained between adding 80 kg N and 120 kg N/ feddan on the above characters. B- Effect of P levels: 1-Phosphorus application significantly affected wheat plant height, fresh and dry weight of plants/ m² and flag leaf area in the combined analysis. 2-Number of leaves/ plant, number of tillers and spikes/ m² were not significantly affected by increasing phosphorus level from zero to 24 kg P₂O₅/ feddan in the combined analysis. C- Effect of microelements : 1 Foliar application of zinc sulphate with manganese sulphate at 0.3 % gave the highest mean values of plant height, fresh weight of plants/ m² and flag leaf area. whereas, no significant difference was obtained between foliar application of zinc sulphate alone or with combined with manganese sulphate on plant height. 2-Number of spikes/ m² significantly increased by application of microelements when compared with the control treatment. Foliar application of zinc sulphate at 0.3 % gave the highest

number of spikes/ m² .3-Foliar application of microelements had no significantly effect on the number of leaves/ plant, dry weight of plants/ m² and number of tillers/ m² .D- Interaction effects:1-There was a significant difference of the average values of fresh weight of plants/ m², number of tillers and spikes/ m² as affected by the interaction between N and P levels in the combined analysis. Application of 120 kg N + 24 kg P205/ feddan gave the maximum mean values of fresh weight of plants/ m², number of tillers and spikes/ m². whereas, the difference between the interaction 120 kg N + 24 kg P205/ feddan and 80 kg N + zero P205 were not significant on number of tillers and spikes/ m².2-The interaction effect between N levels and foliar application of microelements on fresh weight of plants/ m², number of tillers and spikes/ m² were highly significant in the combined analysis. The highest fresh weight of plants/ m² was obtained from adding 120 kg N/ feddan with foliar application of manganese sulphate at 0.3 %. Also, application of 120 kg N/ fed. with foliar spraying of zinc sulphate at 0.3 % gave the maximum number of tillers and spikes/ m².3-Plant height, fresh weight of plants/ m². number of tillers and spikes/ m² were significantly affected by the interaction between P level and microelements in the combined analysis of the two growing seasons. The tallest wheat plant and the greatest number of tillers and spikes/ m² were produced when applied 24 kg P205/ feddan with foliar application of Zn + Mn nutrients. While, adding 24 kg P205/ feddan without foliar application of microelements gave the highest fresh weight of plants/ m² .4-The mean values of fresh weight of plants/ m², number of tillers and spikes/ m² were significantly affected by the interaction between N levels, P levels and foliar application of microelements in the combined analysis. The interaction between 120 kg N/ fed. + 24 kg P205/ feddan with foliar application of MnSO₄ at 0.3 % gave the highest value of fresh weight of plants/ m². Also, the highest number of tillers and spikes/ m² were produced from adding 40 kg N/ fed. without phosphorus fertilizer and foliar application of zinc sulphate at 0.3 % .II- Yield and yield components :A- Effect of N levels :1- Nitrogen application had no significant effect on spike length, spike weight. Grain weight/ spike and 1000- grain weight in the combined analysis.SUMMARY - 105 -2-Number of grains/ spike in the combined analysis, grain yield and biological yield/ feddan in the second season and combined analysis were significantly increased by increasing N level up to 120 kg N/ feddan.3-The increase in level from zero to 40, 80 and 120 kg N/ feddan increased grain yield/ feddan by 6.72, 7.9 and 11.9 % , respectively, over the control. Also, biological yield /feddan gave the same trend when increasing N levels. whereas, no significant difference was obtained between adding 40 and 120 kg N/ feddan on grain yield and biological yield per feddan.B- Effect of P levels :1-Spike characters and 1000- grain weight were slight increases due to applying phosphorus fertilizer at 24 kg P205/ feddan when compared with the control treatment. The increases were far below the level of significance.2-Application of 24 kg P205/ feddan significantly increased grain yield and biological yield/ feddan over the control treatment by 15.2 and 11.6 % , respectively.C- Effect of microelements :1-Foliar application of microelements significantly increased spike length, grain weight/ spike and 1000- grain weight when compared with the untreated plants in the combined analysis.2-Application of ZnSO₄, MnSO₄ and ZnSO₄ + MnSO₄ at the rate of 0.3 % significantly increased grain yield/feddan by 4.3, 4.9 and 8.9 % , respectively over the control treatment in the combined analysis.3- The maximum biological yield/ feddan was produced by foliar application of MnSO₄ at 0.3 % in the combined analysis. whereas, the increases were far below the level of significance.D- Interaction effects :1-The mean values of grains number/ spike in the combined analysis and grain yield/ feddan in the first season and combined analysis of the two growing seasons were significantly affected by the interaction between N and P levels. Application of 120 kg N/ feddan with 24 kg P205/ feddan gave the highest number of grains/ spike and grain yield/ feddan.2-The effect of interaction between N levels and foliar application of microelements were significant on spike weight, number of grains/ spike and 1000- grain weight in the combined analysis as well as grain yield and biological yield/ feddan in the second season and the combined analysis. The maximum grain yield/ feddan was produced from 120 kg N/ feddan with ZnSO₄ + MnSO₄ at 0.3 %.3-There was a significant difference of spike length due to the interaction effect between P levels and microelements. Without application of phosphorus fertilizer with foliar application of manganese sulphate at 0.3 % gave the tallest spike.4- The interaction between the three factors under study had significant effect on spike length and number of grains/ spike in the combined analysis as well

as biological yield/ feddan in the first and second seasons and their combined. Application of 80 kg N + 24 kg P205/ feddan with foliar application of ZnSO₄ + MnSO₄ at 0.3 % caused a significant increase in biological yield by 48.7 % over the control treatment (without application of N, P and microelements).

II Correlation Coefficient :

- 1- There was positive and significant correlation coefficient between spike length and each of spike weight and grain weight/ spike.
- 2- Spike weight was positively and highly significantly correlated with number of grains/ spike and grain weight/spike.
- 3- Significant positive correlation was detected between number of tillers/ m² and number of spikes/ m² as well as between grain yield feddan and biological yield/feddan.

IV Grain quality :

A- Effect of N levels :

- 1-Nitrogen application had no significant effect on Zn and Mn content in wheat grain in the combined analysis.
- 2-Percentage of N and protein content in wheat grain in the combined analysis as well as protein yield per feddan in SUMMARY - 108 -both seasons and combined analysis were significantly increased by increasing N levels up to 120 kg N/ feddan.
- 3- The application of 120 kg N/ feddan increased protein yield by 60.97% over without fertilizer of nitrogen in the combined analysis.

B- Effect of P levels :

- 1-Zn concentration in wheat grain was highly significantly decreased by increasing phosphorus level up to 24 kg P205/ feddan in the combined analysis.
- 2-Phosphorus levels had no significant effect on Mn content, percentage of N and protein in wheat grain.
- 3-Application of 24 kg P205/ feddan significantly increased protein yield/ feddan over the check treatment by 22.8, 10.77 and 16.5 % in the first and second seasons and combined analysis , respectively.

C- Effect of microelements :

- 1-Foliar application of zinc sulphate caused significant increases of the mean values of Zn content in wheat grain.
- 2-Foliar application of ZnSO₄, MnSO₄ and ZnSO₄ + MnSO₄ at 0.3 % significantly increased the mean values of Mn content in wheat grain by 23.94, 25.49 and 16.72% over untreated plants , respectively.
- 3-Percentage of N and protein in wheat grain were not significantly affected by foliar application of microelements in the combined analysis.
- 4-Protein yield/ feddan was significantly increased by foliar application of microelements in the combined analysis. Foliar application of MnSO₄ at 0.3 % gave the highest mean values of protein yield/ feddan.

D- Interaction effects :

- 1-The interaction effect between N levels and P levels were significant on Zn content, percentage of N and protein in wheat grain in the combined analysis as well as protein yield/ feddan in the first season and combined analysis of the two growing seasons. Application of 120 kg N/ fed. without application of phosphorus gave the highest Zn content, percentage of N and protein in wheat grain. whereas, the maximum mean values of protein yield/ fed. was obtained from adding 120 kg N + 24 kg P205/ feddan.
- 2-The average values of Zn and Mn content in wheat grain in the combined analysis as well as protein yield/ feddan in both seasons and combined analysis were significantly affected by the interaction between N levels and foliar application of microelements. The highest mean values of Zn and Mn content were produced from applied 120 kg N/ fed. with foliar application of zinc sulphate. whereas, application of 120 kg N/ feddan + MnSO₄ at 0.3 % gave the maximum protein yield/ feddan.
- 3-There were a significant differences of Mn content, percentage of N and protein content in the combined analysis as well as protein yield/ feddan in both seasons and combined analysis due to the interaction effect between P levels and foliar application of microelements .The highest mean values of Mn content, N % and protein % as well as protein yield/ feddan were obtained from adding 24 kg P205 + foliar application of ZnSO₄ with MnSO₄ at 0.3 % or with any microelements alone.
- 4- The interaction between N levels, P levels and foliar application of microelements significantly affected Zn and Mn content, percentage of N and protein in wheat grain in the combined analysis and protein yield/ feddan in both seasons and combined analysis. Application of 120 kg N + zero P + ZnSO₄ at 0.3 % gave the maximum mean values of Zn content. The highest values of Mn content was produced from 80 kg N + 24 kg P205/ feddan + MnSO₄ at 0.3 % . Also, application of 120 kg N + zero P + foliar spraying of ZnSO₄ + MnSO₄ at 0.3 % significantly increased N and protein content in wheat grain. The maximum mean values of protein yield/ feddan was produced from adding 120 kg N + 24 kg P205 with foliar application of zinc sulphate at 0.3 %