Determination of five mineral element contents in pollen grains of different seedling date palm (Phoenix Dactylifera L.) male trees grown in Fayoum Governorate, Egypt

Abstract

This experiment was conducted to found the connection between sensible male pollinators and the content from mineral element (Zinc, Iron, Manganese, Cupper and Magnesium) in pollen grain of fifty seedling date palm male and compared it with the best selective five seedling date palm male (number 2, 10, 29, 40, 46) are appropriate and promising males for to be utilized in pollinating female date palm and mistreatment in breeding programs in previous study. Results found variations among the categories of pollen and elements. The highest concentration of zinc was found in males’ number (2, 10, 40 and 46) which recorded 127,102, 115 and 122 µg/g dry weight respectively as compared to the other male trees. Also the highest concentration of iron was found in male number (40) which recorded 222 µg/g dry weight as compared to the other male trees. Moreover, notes from result excellence male number (10) in manganese concentration which recorded 202 µg/g dry weight as compared to the other male trees. In this concern, pollen grain of date palm male trees contained also, high concentrations of copper and magnesium the concentration ranging from 10 to 30 and 1320 to 1985 µg/g dry weight for copper and magnesium respectively. The best value for copper and magnesium which obtained from the selective male number (46) which recorded 30 and 1985 µg/g dry weight for copper and magnesium respectively as compared to the other male trees. From all the results we can conclude that the date palm pollen grain was as rich source of important minerals, so its suitability as a regular component in plant and human diet.

Keywords: male date pal, zinc, iron, manganese, cupper, magnesium

Introduction

Date palm (Phoenix dactylifera L.) is one amongst the oldest cultivated trees in world. In Egypt, Phoenix dactylifera tree is taken into account joined of the foremost vital fruits wherever it’s cosmopolitan in numerous areas in Egypt from the Mediterranean coast up to Assouan. Its cosmopolitan in numerous districts of the planet districts of the world. It constitutes the foremost vital plant in arid and desert areas wherever it provides favorable conditions for both human and animal habitats. In fact, feather palm as Associate in Nursing irreplaceable tree in irrigable desert lands grows underneath unfavorable conditions wherever several of the opposite fruit species doesn’t. It additionally keeps alternative crops settled under that from heat, wind, and even cold weather. So, it plays an enormous role to prevent geologic process and provides life to desert areas.3,4 Date palm could be a diocious perennial and monocotyledonous fruit tree that belongs to the Areaceae family. Several investigators studied the effect of pollens obtained from totally different palm males cultivar on fruit set, yield and fruit physical and chemical properties of many female palm cultivars.5-10 The direct influence of the male parent on the event of the date fruit is precise and definite and varies with the actual male wont to fertilize the female flowers. Every male exerting just about constant impact on fruit of all varieties and exerting constant impact in several years. Therefore, it’s vital to select and identify superior male in term of fertilization. The concentration of mineral components in spore grains of feather date palm males were studied by many workers.11-17 In addition, several investigators mentioned that, the effect of micro-nutrient in spore grain germination and pollen tube growth in several plant species.18,19 The minerals content in pollen grains differed from one seedling plant males to a different. The macronutrients, N was gift within the highest concentrations, followed by Ca, P, Mg and Na, whereas the micronutrients, Fe was gift within the highest concentrations, followed by Zn, Mn and Cu.20 The aim of this study is to found the connection between sensible male pollinators and the content from mineral element (Zinc, Iron, Manganese, Cupper and Magnesium) in pollen grain of fifty seedling date palm male and compared it with the best selective five seedling date palm male (number 2, 10, 29, 40, 46) are appropriate and promising males for to be utilized in pollinating female date palm and mistreatment in breeding programs in previous study. Results found variations among the categories of pollen and elements. The highest concentration of zinc was found in males’ number (2, 10, 40 and 46) which recorded 127,102, 115 and 122 µg/g dry weight respectively as compared to the other male trees. Also the highest concentration of iron was found in male number (40) which recorded 222 µg/g dry weight as compared to the other male trees. Moreover, notes from result excellence male number (10) in manganese concentration which recorded 202 µg/g dry weight as compared to the other male trees. In this concern, pollen grain of date palm male trees contained also, high concentrations of copper and magnesium the concentration ranging from 10 to 30 and 1320 to 1985 µg/g dry weight for copper and magnesium respectively. The best value for copper and magnesium which obtained from the selective male number (46) which recorded 30 and 1985 µg/g dry weight for copper and magnesium respectively as compared to the other male trees. From all the results we can conclude that the date palm pollen grain was as rich source of important minerals, so its suitability as a regular component in plant and human diet.

Keywords: male date pal, zinc, iron, manganese, cupper, magnesium

Materials and methods

Plant materials

The study was conducted during the three successive seasons 2015, 2016 and 2017 on fifty seedling date palm males about 30 years old and grown in Sand clay loamy soil at Tamiya district, Fayoum Governorate, Egypt. Moreover, the study included the five date palm
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Males coded by numbers (2, 10, 29, 40 and 46) which select according to the evaluation results of more previously studies.8–10 as good male pollinators for further using in pollinating female date palms and breeding programs.

Collection of plant material
Date Palm pollen was collected in March (2015, 2016 and 2017) from Tamiya district, Fayoum Governorate, Egypt. Some of palm pollen grains (Phoenix dactylifera L.) were collected and separated from the kernels with a fine gauze sieve and dried at 70°C and then kept in closed container.

Chemical composition:
Dried pollen grain were used for determination. Iron, zinc, manganese, copper and magnesium contents as µg/g dry weight by using atomic absorption spectrophotometer apparatus according.25,26 Data were statistically analyzed according.27 Data presented in the Table of this investigation represent the mean of the three experimental seasons.

Results

Micro nutrient
Zinc concentrations: Data presented in Table 1 indicate that Pollen grain of date palm male trees contained high concentrations of zinc, the concentration ranging from 49 to 127µg/g dry weight. The best result which obtained from the selective males number (2, 10, 40 and 46) which recorded 127, 102, 115 and 122 µg/g dry weight respectively as compared to the other male trees.

Iron concentrations: Data presented in Table 2 indicate that Pollen grain of date palm male trees contained also high concentrations of iron, the concentration ranging from 145 to 222µg/g dry weight. The best result which obtained from the selective male number (40) which recorded 222 µg/g dry weight respectively as compared to the other male trees.

Manganese concentrations: Data presented in Table 3 indicate that Pollen grain of date palm male trees contained high concentrations of iron, the concentration ranging from 97 to 202µg/g dry weight. The best result which obtained from the selective male number (10) which recorded 202 µg/g dry weight respectively as compared to the other male trees.

Copper concentrations: Data presented in Table 4 indicate that pollen grain of date palm male trees contained low concentrations of copper, the concentration ranging from 10 to 30 µg/g dry weight. The best result which obtained from the selective male number (40) which recorded 30 µg/g dry weight respectively as compared to the other male trees.

Macro nutrient
Magnesium concentrations: Data presented in Table 5 indicate that Pollen grain of date palm male trees contained high concentrations of magnesium, the concentration ranging from 1320 to 1985 µg/g dry weight. The best result which obtained from the selective male number (46) which recorded 1985 µg/g dry weight respectively as compared to the other male trees.

Table 1 Pollen zinc content of date palm males as the mean of the three seasons studied

| Male No. | Zn µg/g dry weight | Male No. | Zn µg/g dry weight |
|----------|--------------------|----------|--------------------|
| 1        | 88                 | 6         | 92                 |
| 2        | 127                | 27       | 95                 |
| 3        | 95                 | 28       | 70                 |
| 4        | 93                 | 29       | 98                 |
| 5        | 74                 | 30       | 81                 |
| 6        | 55                 | 31       | 63                 |
| 7        | 62                 | 32       | 66                 |
| 8        | 81                 | 33       | 53                 |
| 9        | 49                 | 34       | 84                 |
| 10       | 102                | 35       | 84                 |
| 11       | 73                 | 36       | 90                 |
| 12       | 92                 | 37       | 77                 |
| 13       | 94                 | 38       | 94                 |
| 14       | 82                 | 39       | 63                 |
| 15       | 83                 | 40       | 115                |
| 16       | 83                 | 41       | 51                 |
| 17       | 60                 | 42       | 65                 |
| 18       | 64                 | 43       | 83                 |
| 19       | 58                 | 44       | 90                 |
| 20       | 79                 | 45       | 95                 |
| 21       | 88                 | 46       | 122                |
| 22       | 67                 | 47       | 59                 |
| 23       | 72                 | 48       | 57                 |
| 24       | 75                 | 49       | 92                 |
| 25       | 83                 | 50       | 64                 |

Mean of seasons, 2015, 2016 and 2017**
Coefficient of variation**
Table 2 Pollen iron content of date palm males as the mean of the three seasons studied

| Male No. | Fe µg/g dry weight | Male No. | Fe µg/g dry weight |
|---------|-------------------|---------|-------------------|
| Mean*   | C.V.**            | Mean*   | C.V.**            |
| 1       | 167               | 26      | 148               | 5.15              |
| 2       | 184               | 27      | 183               | 9.21              |
| 3       | 204               | 28      | 199               | 25.15             |
| 4       | 201               | 29      | 149               | 10.28             |
| 5       | 217               | 30      | 162               | 12.2              |
| 6       | 193               | 31      | 208               | 9.28              |
| 7       | 205               | 32      | 174               | 11.11             |
| 8       | 221               | 33      | 172               | 12.55             |
| 9       | 145               | 34      | 160               | 6.18              |
| 10      | 188               | 35      | 231               | 10.14             |
| 11      | 198               | 36      | 153               | 6.33              |
| 12      | 200               | 37      | 160               | 14.25             |
| 13      | 182               | 38      | 178               | 16.6              |
| 14      | 164               | 39      | 192               | 15.66             |
| 15      | 145               | 40      | 193               | 15.35             |
| 16      | 222               | 41      | 184               | 14.2              |
| 17      | 191               | 42      | 205               | 10.18             |
| 18      | 203               | 43      | 209               | 10.89             |
| 19      | 175               | 44      | 187               | 11.33             |
| 20      | 188               | 45      | 161               | 8.61              |
| 21      | 207               | 46      | 222               | 14.15             |
| 22      | 202               | 47      | 176               | 15.04             |
| 23      | 170               | 48      | 206               | 21.18             |
| 24      | 177               | 49      | 202               | 10.74             |
| 25      | 216               | 50      | 185               | 9.78              |

Mean of seasons, 2015, 2016 and 2017*

**Coefficient of variation

Table 3 Pollen manganese content of date palm males as the mean of the three seasons studied

| Male No. | Mn µg/g dry weight | Male No. | Mn µg/g dry weight |
|---------|-------------------|---------|-------------------|
| Mean*   | C.V.**            | Mean*   | C.V.**            |
| 1       | 134               | 26      | 129               | 3.25              |
| 2       | 191               | 27      | 133               | 5.68              |
| 3       | 182               | 28      | 97                | 3.54              |
| 4       | 178               | 29      | 136               | 10.54             |
| 5       | 112               | 30      | 189               | 10.25             |
| 6       | 98                | 31      | 194               | 12.25             |
| 7       | 155               | 32      | 203               | 11.82             |
| 8       | 192               | 33      | 158               | 9.28              |
| 9       | 141               | 34      | 182               | 8.92              |
| 10      | 202               | 35      | 179               | 10.25             |
| 11      | 154               | 36      | 192               | 9.44              |
| 12      | 177               | 37      | 186               | 8.15              |
| 13      | 168               | 38      | 172               | 6.18              |
| 14      | 136               | 39      | 194               | 10.52             |
| 15      | 121               | 40      | 157               | 8.25              |
| 16      | 166               | 41      | 142               | 5.15              |
| 17      | 192               | 42      | 154               | 4.27              |
| 18      | 143               | 43      | 193               | 9.88              |
| 19      | 129               | 44      | 171               | 10.55             |
| 20      | 155               | 45      | 185               | 11.33             |
| 21      | 181               | 46      | 157               | 12.25             |
| 22      | 138               | 47      | 142               | 10.22             |
| 23      | 141               | 48      | 194               | 10.54             |
| 24      | 174               | 49      | 173               | 12.12             |
| 25      | 187               | 50      | 184               | 16.1              |

Mean of seasons, 2015, 2016 and 2017*

**Coefficient of variation

Citation: Yazal MASEI, Yazal SASEI. Determination of five mineral element contents in pollen grains of different seedling date palm (Phoenix Dactylifera L.) male trees grown in fayoum Governorate, Egypt. Horticult Int J. 2019;3(3):140–145. DOI: 10.15406/hij.2019.03.00121
Table 4 Pollen Copper content of date palm males as the mean of the two seasons studied

| Male No. | Cu µg/g dry weight | Male No. | Cu µg/g dry weight |
|----------|--------------------|----------|--------------------|
| Mean*    | C.V.**             | Mean*    | C.V.**             |
| 1        | 16                 | 26       | 14                 | 1.14               |
| 2        | 10                 | 27       | 13                 | 1.35               |
| 3        | 22                 | 28       | 24                 | 1.58               |
| 4        | 14                 | 29       | 21                 | 1.87               |
| 5        | 25                 | 39       | 21                 | 1.65               |
| 6        | 32                 | 33       | 23                 | 1.24               |
| 7        | 30                 | 32       | 15                 | 1.65               |
| 8        | 29                 | 33       | 21                 | 1.38               |
| 9        | 11                 | 34       | 12                 | 1.59               |
| 10       | 17                 | 35       | 26                 | 1.34               |
| 11       | 14                 | 36       | 22                 | 2.01               |
| 12       | 13                 | 37       | 18                 | 2.35               |
| 13       | 15                 | 38       | 29                 | 3                  |
| 14       | 12                 | 39       | 15                 | 1.15               |
| 15       | 18                 | 40       | 27                 | 2.01               |
| 16       | 15                 | 41       | 23                 | 2.05               |
| 17       | 20                 | 42       | 20                 | 2.06               |
| 18       | 19                 | 43       | 14                 | 1.32               |
| 19       | 23                 | 44       | 28                 | 1.89               |
| 20       | 21                 | 45       | 24                 | 1.54               |
| 21       | 24                 | 46       | 30                 | 2.06               |
| 22       | 13                 | 47       | 15                 | 1.11               |
| 23       | 20                 | 48       | 29                 | 1.42               |
| 24       | 25                 | 49       | 12                 | 1.11               |
| 25       | 30                 | 50       | 25                 | 1.68               |

Mean of seasons, 2015, 2016 and 2017*

Coefficient of variation**

Table 5 Pollen magnesium content of date palm males as the mean of the three seasons studied

| Male No. | Mg µg/g dry weight | Male No. | Mg µg/g dry weight |
|----------|--------------------|----------|--------------------|
| Mean*    | C.V.**             | Mean*    | C.V.**             |
| 1        | 1330               | 16.05    | 26                 | 1840               | 16.33             |
| 2        | 1670               | 17.28    | 27                 | 1940               | 15.17             |
| 3        | 1450               | 18.33    | 28                 | 1450               | 12.32             |
| 4        | 1940               | 18.54    | 29                 | 1320               | 14.25             |
| 5        | 1680               | 18.69    | 30                 | 1520               | 15.26             |
| 6        | 1130               | 19.04    | 31                 | 1830               | 17.77             |
| 7        | 1980               | 19.35    | 32                 | 1220               | 18.39             |
| 8        | 1320               | 16.33    | 33                 | 1340               | 14.35             |
| 9        | 1960               | 16.54    | 34                 | 1530               | 16.33             |
| 10       | 1340               | 18.21    | 35                 | 1820               | 17.28             |
| 11       | 1460               | 16.16    | 36                 | 1470               | 17.95             |
| 12       | 1970               | 15.24    | 37                 | 1960               | 16.13             |
| 13       | 1950               | 15.36    | 38                 | 1780               | 16.19             |
| 14       | 1350               | 16.66    | 39                 | 1660               | 18.17             |
| 15       | 1930               | 16.32    | 40                 | 1430               | 13.25             |
| 16       | 1720               | 17.21    | 41                 | 1940               | 16.25             |
| 17       | 1880               | 19.18    | 42                 | 1350               | 11.38             |
| 18       | 1930               | 19.32    | 43                 | 1230               | 16.35             |
| 19       | 1490               | 14.13    | 44                 | 1680               | 10.82             |
| 20       | 1360               | 12.16    | 45                 | 1920               | 18.39             |
| 21       | 1500               | 13.15    | 46                 | 1985               | 10.1              |
| 22       | 1830               | 14.25    | 47                 | 1840               | 11.66             |
| 23       | 1610               | 14.36    | 48                 | 1670               | 15.25             |
| 24       | 1450               | 15.15    | 49                 | 1450               | 13.25             |
| 25       | 1720               | 16.26    | 50                 | 1940               | 16.21             |

Mean of seasons, 2015, 2016 and 2017*

Coefficient of variation**

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Discussion

It is clear from the current information that the great male pollenators for using in pollinating female date palms (five seedling date palm males number, 2, 10, 29, 40, 46) was characterized by high content of the estimated element (Zinc, Iron, Manganese, Copper and Magnesium). In this respect,29 pointed that feather date palm pollen (phoenix dactylifera L) is particular high mineral content. This could be associated with the high mineral content of the soil horizons in dry areas wherever this species grows. But, the capability of the parent plant to accumulate elements within the pollen is additionally associated with the species. Moreover,29 found that Egyptian pollen grain contain higher quantity of copper 3.196 mg/g with lower quantity of manganese 2.84mg/g, zinc 2.81mg/g and iron 2.41mg/g. The elements Fe, Mg, Mn, Zn and Cu have been classified as essential elements for the plants and human diet.28,29 While not copper, iron cannot be properly reborn to its usable30 whereas the Mg content within the pollen grains also reduced risk of stroke.31 The presence of Mg2+; Cu2+, Fe3+; Mn2+ and Zn2+ reflects their perform as essential nutrient components, typically as cofactor activators in metal-ligand enzyme complexes.29 The healthful importance of pollen grain could also be thanks to its content of Zn that is beneficial to manufacture of testosteron, as antioxidant and essential for traditional functioning of the male reproductive system,29,32 in contribution of Mn33 which also are essential for traditional functioning of central system nervous and are an honest anti-oxidant.33 Workers, rumored that, iron plays a task in syntheses of RNA, reduction of nitrate to ammonia,34 chlorophyll syntheses,35 nucleic acid metabolism and chemical change and structural roles of Fe2+ and Fe3+ in plant.36 Also, iron is either a constituent or a cofactor of many antioxidative enzymes, and might acts as a pro-oxidant issue as a result of free or loosely bound Fe2+ catalyses free radical generation within the presence of reductants and peroxides through the Fenton reaction. In particular, Fe is involved in the Fe2+ catalysed Haber–Weiss reaction in which trace amounts of Fe2+ are reduced by to produce Fe2+ which, in turn, reacts with H2O2 to form OH (Fenton reaction). As the intrinsic constituent or metal compound, iron is actively concerned in cellular detoxification reactions catalysed by enzyme, phenolic-dependent peroxidases (non-specific peroxidases, ascorbate peroxidases and metallic element SOD), that scavenge oxygen and superoxide, therefore protective the cell from aerobicous injury. As the intrinsic constituent or metal cofactor, iron is actively concerned in cellular detoxification reactions catalysed by enzyme catalse, phenolic-dependent peroxidases (non-specific peroxidases, ascorbate peroxidases and Fe superoxide dismutase, which scavenge hydrogen peroxide and superoxide, therefore protective the cell from aerobicous injury. In this respect,37 reported that, iron deficient helianthus plants appears to have an effect on totally different the various peroxidase isoenzymes to different extents and to induce a secondary aerobic oxidative stress, as indicated by the redoubled levels of H2O2. On the opposite hand, the foremost vital perform of manganese is said to the oxidation-reduction processes.38 It may be used as a cofactor of many enzymes that act as phosphorylated substrates; conjointly, it plays a task in control the amount of plant hormones (auxins) in plant tissues by activating the auxin oxidation system.39 The essential role of atomic number 30 is said to the synthesis of essential amino acid organic compound and consequently formation of phytohormone i.e. IAA that act as plant hormone particularly in prolonging height of plants.38 Zinc has a vital role in carbohydrate metabolism, protein synthesis, essential amino acid and IAA synthesis, since it activates variety of enzymes for photosynthesis.40 The essential role of Zn is related to the synthesis of tryptophan amino acid and consequently formation of phytohormone i.e. IAA that act as plant hormone particularly in prolonging height of plants.38 Zinc has a vital role in carbohydrate metabolism, protein synthesis, essential amino acid and IAA synthesis, since it activates variety of enzymes for photosynthesis.40 Also,41 rumored that, the rise in spore grain from Mg, Zn, Mn, iron and atomic number 29 is various components of the plant. The stimulating impact of micronutrients on plant growth is also because of their role in lepton transmission from water to chlorophyll and manufacturing O2 gas within the chemical change, additionally to their role within the gas metabolism through activated group enzyme catalyst.42 Also, the favorable impact of Mg, Zn, Fe, Mn and atomic number 29 on yield and its elements in antecedently studied by43 may be attributed to the rise in photosynthetic pigments concentration44 moreover as, catalyst activity, consequently improvement of plant metabolism.41 Also,45 reported that, the rise in Pollen grain from Mg, Zn, Mn, Fe and Cu also because of the impact of Zn on synthesis of phytohormone (I.A.A.) that promote ontogenesis process and consequently the amounts of mineral elements absorbed and trans placed into the various components of the plant. The stimulating impact of micronutrients on plant growth is also because of their role in electron transmission from water to chlorophyll and manufacturing oxygen gas within the photosynthesis, additionally to their role within the nitrogen metabolism through activated nitrite reductase enzyme.42 Also, the favorable impact of Mg, Zn, Fe, Mn and Cu on yield and its components in antecedently studied by46 may be attributed to the rise in photosynthetic pigments concentration47 moreover as, enzyme activity, consequently improvement of plant metabolism.41

Conclusion

Finally, from the present results, it could be concluded that the good male pollenators for using in pollinating female date palms was characterized by high content from elements (Zinc, Iron, Manganese, Copper and Magnesium). Which reflected greatly on fertility and yield, and consequently improved quality of fruits because these elements participate in the different metabolic processes. Moreover, it could be recommended to fertilizing date palm males trees with micronutrients of (Fe, Zn, Mn, Cu, Mg) for increase vitality of Pollen grains of date Palm male trees and greatly increased yield.

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None.

Conflicts of interest

The author declares there is no conflicts of interest.

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