Impact of spraying potassium nitrate, garlic or onion extract on flowering behaviour, yield, fruit quality and some chemical constituents of "Anna" apple (Malus sylvestris, Mill) variety

Mohamed A Seif El Yazal and Morsi M E

Fayoum University, Egypt

Abstract:
This investigation was carried out during the two successive seasons of 2006 and 2007 to investigate the effect of potassium nitrate, garlic extract and onion extract on bud break, growth, yield and some chemical constituents of "Anna" apple (Malus sylvestris, Mill) variety . The trees were grown in loamy sand soil, and sprayed with six treatments (potassium nitrate 10%), garlic extract (20%), onion extract (20%), potassium nitrate (5%) mixed with garlic extract (10%) ,potassium nitrate (5%) mixed with onion extract (10%) and control. Generally, it was found that all studied growth parameters , date of flower bud break, percentage of bud break, fruit-setting ,fruit weight, fruit size, fruit number/tree, yield/tree (kg) and some chemical constituents of leaves (total chlorophyll ,total carbohydrates, total protein, nitrogen, phosphorous and potassium contents) and some chemical constituents of fruits (total soluble solids(T.S.S.), T.S.S/ acid ratio, vitamin C, water content %, total free amino acids, total carbohydrates, total sugars and reducing sugars) were increased with the application of the different treatments. The best results were obtained from the treatments of potassium nitrate at 5% mixed with onion extract at 10%, potassium nitrate at 5% mixed with garlic extract at 10% and potassium nitrate at 10%. On the contrary, the same treatments decreased total acidity and total phenols in fruits as compared to the control. It could be recommended to use potassium nitrate at 5% in combination with onion extract or garlic extract at 10% for improving bud break, growth, yield and chemical constituents of apple trees or fruits.

Introduction:

The apple tree is a fruit-bearing deciduous temperate climate, which requires a certain amount of winter cold to overcome its lethargy, a physiological condition that occurs annually to survive cold winters (Petri and Leite, 2010; Seif El-Yazal et al., 2012).

However, it is difficult to determine the precise amount of cold that is required to get out of lethargy (Carvajal-Millan et al., 2000). This deficiency of cold affects a late sprouting in terminal buds, a poor and irregular flowering, large number of buds without sprouting, low fruit tie, low production and poor quality, as well as an increased risk of fire blight (Quintana, 2006). A management strategy to reduce problems of insufficient cooling is the application of cold compensators.

Among the compensators mentioned in the literature and that have been applied are: potassium nitrate, garlic extract, onion extract, mineral oils, dormex (hydrogenated cyanamide), aminoburts, semitrol, break trhu, Tecno Oil 100EW, calcium nitrate, revent, promalin, biozyme, thidiazuron (TDZ) and erger which widely used for stimulating bud break in various fruit species (Quintana, 2006 and Botelho and Muller, 2007).
The beneficial effect of potassium nitrate, garlic and onion extract on bud break, growth, yield and some chemical constituents of different fruit species were studied by several workers (Khayat et al., 2010; Petri and Leite,2010; Abd El-Rzeket et al., 2011; Rady and Seif El-Yazal, 2014, Seif El-Yazal and Rady,2014; Seif El-Yazal et al., 2018&2019;Parra et al.,2020).

Materials and Methods:

This study was carried out during the two successive seasons of 2006 and 2007 in the orchard of the Horticulture Farme of Faculty of Agriculture, Fayoum University in an attempt to break dormancy of "Anna" apple variety (Malus sylvestris, Mill) grafted on Malling-Merton 106 (MM 106) root stock. The trees were 10 years old when experiment started and grown in loamy sand soil. Trees were selected in November, 2005 a uniform as possible for spray treatments.

The experiment involved the following treatments
1. Control (spraying with tap water)
2. Spraying with potassium nitrate at rate 10%
3. Spraying with garlic extract at rate 20%
4. Spraying with onion extract at rate 20%
5. Spraying with potassium nitrate at rate 5%+ garlic extract at rate 10%
6. Spraying with potassium nitrate at rate 5%+ onion extract at rate 10%

In all experiments, Phosphorous as calcium super phosphate (15.5% P2O5) at the rate of 200 kg/fed., was added in the orchard in the second week of February. Nitrogen as ammonium nitrate (33.5% N) at the rate of 250 kg /fed. was added in two doses for the orchard (first dose 150 kg/fed. in the second week of February and second dose 100 kg./fed. before top flowering (first week of April)) and potassium sulphate (48% K2O) at the rate of 50 kg/fed., was given in two equal doses in alternative with nitrogen fertilizer. The first dose of fertilizer was added in (March) and the second dose given after 30 days from the first one. The other cultural practices were followed as normal. The control trees were sprayed with tap water, however, potassium nitrate (containing 13% nitrogen and 44% potassium), garlic extract and onion extract were sprayed at two equal doses, the first was sprayed before the end of dormancy (nearly 30th of December), and the second was applied two weeks later with a volume of 4 L/tree for each one. Triton B as a wetting agent at 0.1% was added to the spraying solutions.

Preparation of garlic and onion extracts:

Garlic or onion samples were ground using mortar and pestle and the active ingredients were extracted by ethyl alcohol (95%). The garlic or onion ethanol mixture was filtered and the alcohol was removed by evaporating under vacuum (30C°) using rotary evaporator, Buchi model 011. The extract was kept cool in refrigerator (4C°) until use. Garlic or onion extract was diluted by water to give the final concentration required (10 and 20 %) directly before use.

Data recorded:
A. Morphological characteristics

In both the two successive seasons, bud counts were made for each tree. The dates on which flower and vegetative bud started to open were recorded. Number of vegetative and flower buds was counted when all buds were opened and the percentages were estimated. The dormant buds were also counted and were expressed as percentage from the total number of buds. The dates at which flowering reached 25, 50, 75 and 100 percent of the total flowers were estimated in each treatment. Flowers whose calyx began to extend were tagged in order to determine the percent of fruit set. The yield of fruits in kg/tree as well as the numbers of mature fruits/ tree were recorded when fruits reached the commercial colour to be picked.

In order to determine fruit quality, 20 fruits were taken at random from each tree as a sample. Samples were transferred immediately to the laboratory. Each fruit was weighed to get the average fruit weight. Average fruit size was determined by emerging the fruit in a jar containing water and receiving the excess water in a graduated cylinder.

Chemical analysis:

Fresh and dried leaves as well as fruits (May15 th for chemical constituents & 30th July for mineral elements in leaves and at harvesting, for fruits) were taken to determine the following constituents: total chlorophyll was extracted from fresh leaves by acetone (80%) and its concentration was determined as mg/100g fresh weight according to Welburn and Lichtenthaler (1984), total carbohydrates mg/g dry weight were determined colorimetrically by using phenol-sulphuric acid reagent according to the method described by Herbert et al. (1971). Total free amino acids in fresh fruits were determined as mg/g fresh weight colorimetrically using ninhydrin reagent according to the method described by Jayarman (1981). (Total and reducing sugars were determined as mg/g fresh weight using phosphomolybdic acid reagent., total phenols in fresh fruits were determined as mg/g fresh weight using Folin-Denis reagent. Water content in fruits was determined, total soluble solids (T.S.S.) in fruits were estimated using handle Refractometer model PZONr. 19877, total acidity was estimated in fruits as malic acids using sodium hydroxide for a known normality and phenolphthaline as an indicator. Total soluble solids/ acid ratio were calculated and vitamin C content in fruits, Nitrogen %, crude protein percentage and phosphorus % in dry leaves were determined according to A.O.A.C., 1995). Potassium was determined by Flame Photometer, Parkin–Elmer model 52 according to the method described by Page et al. (1982).