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Research Article

IMPACT OF FOLIAR-APPLIED DORMANCY-BREAKING AGENTS ON FLOWERING BEHAVIOR, YIELD, FRUIT QUALITY, AND SOME CHEMICAL CONSTITUENTS OF "EIN SHAMER" APPLE TREES

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ABSTRACT

Objective: This investigation was carried out during the two successive seasons of 2016 and 2017 to investigate the effect of Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea on bud break, growth, yield, and some chemical constituents of "Ein Shamer" apple (*Malus sylvestris*, Mill) variety.

Methods: The trees were grown in loamy sand soil, and sprayed with six treatments (Dormex (4%), mineral oil (5%), potassium nitrate (8%), calcium nitrate (8%), and thiourea (2%) and control.

Results: In general, 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.

Conclusion: The best results were obtained from the treatment of Dormex at 4% and mineral oil (5%). On the contrary, the same treatment decreased total acidity and total phenols in fruits as compared to the control. It could be recommended to use Dormex at 4% and mineral oil (5%) for improving bud break, growth, yield, and chemical constituents of apple trees or fruits.

Keywords: apple (*Malus sylvestris*, Mill), Dormex, Calcium nitrate, Potassium nitrate, mineral oil, Thiourea, Bud break, Growth, Yield, Chemical constituents.

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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 [1-7].

However, it is difficult to determine the precise amount of cold that is required to get out of lethargy [8-12]. 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 [13-15]. 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: Calcium nitrate, potassium nitrate, mineral oil, thiourea, garlic extract, onion extract, Dormex (hydrogenated cyanamide), aminoburts, semitrol, break trhu, Tecno Oil 100EW, calcium nitrate, revent, promalin, biozyme, thidiazuron, and erger which widely used for stimulating bud break in various fruit species [16-21].

The beneficial effect of Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea on bud break, growth, yield, and some chemical constituents of different fruit species was studied by several workers [1,22-28].

METHODS

The 12-year-old trees of "Ein Shamer" apple variety (*Malus sylvestris,* Mill) grafted on Malling-Merton 106 (MM 106) root stock were designated randomized, for a preliminary study in 2015/2016 and for the most analysis studies within the 2016/2017 and 2017/2018 seasons in an attempt to break dormancy. All trees were full-grown within the wood let (loamy sand soil) of the Horticultural Station at Aboksah in Abshawai, Fayoum, Egypt. Trees were selected in November, 2015 a uniform as possible for spray treatments.

The experiment involved the following treatments

1. Control (spraying with tap water)
2. Spraying with Dormex at rate 4%
3. Spraying with mineral oil at rate 5%
4. Spraying with potassium nitrate at rate 8%
5. Spraying with calcium nitrate at rate 8%
6. Spraying with thiourea at rate 2%.

The physical and chemical characters of the orchard soil were determined according to Wilde *et al.* [29] and the results are shown in Table 1.

In all experiments, phosphorous as calcium super phosphate (15.5% P_2O_5) at the rate of 200 kg/fed was added in the orchard in the 2nd week of February. Nitrogen as ammonium nitrate (33.5% N) at the rate of 250/fed was added in two doses for the orchard – first dose 150 kg/fed in the 2nd week of February and second dose 100 kg/fed before top flowering (1st week of April) and potassium sulfate (48% K_2O) 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, Dormex, calcium nitrate, potassium nitrate, mineral oil, and thiourea were sprayed before the end of dormancy (nearly 30th of December), 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.

Data recorded

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% 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 number of mature fruits/tree was recorded when fruits reached the commercial color to be picked.

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 jar containing water and receiving the excess water in a graduated cylinder.

Chemical analysis

Fresh and dried leaves as well as fruits (May 15th for chemical constituents and 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 [30], total carbohydrates mg/g dry weight were determined colorimetrically using phenol-sulfuric acid reagent according to the method described by Herbert *et al.* [31]. Total free amino acids in fresh fruits were determined as mg/g fresh weight colorimetrically using ninhydrin reagent according to the method described by Herbert [32]. 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 phenolphthalein as an indicator. T.S.S./acid ratio were calculated and Vitamin C content in fruits, Nitrogen %, crude protein percentage, and phosphorus % in dry leaves were determined according to AOAC [33]. Potassium was determined by Flame Photometer, Parkin–Elmer model 52 according to the method described by Page *et al.* [34].

Statistical analysis

The experiment was in a complete randomized block design with 6 treatments and 3 replicates for each treatment. One tree was used as a replicate. Results were statistically analyzed using the L.S.D. at probability level of 5% for comparisons according to Gomez and Gomez [35].

RESULTS

Date of flower bud break

Data presented in Table 2 clearly indicated that spraying apple trees with all the tested substances hastened the beginning of flower bud break as compared to the control. This earliness reached about 32 and 31 days for Dormex at 4%, 18 and 19 days for mineral oil at 5%, 20 and 24 days for potassium nitrate at 8%, 17 and 19 days for calcium nitrate at 8%, and 18 and 19 days for thiourea at 2% over the control in both seasons, respectively.

As regards to the effect of the tested substances on 50% bud break, the present results clearly show that all treatments hastened 50% bud break as compared to the control. This earliness reached about 28 and 30 days for Dormex at 4%, 7 and 6 days for mineral oil at 5%, 4 and 7 days for potassium nitrate at 8%, 7 and 7 days for calcium nitrate at 8%, and 5 and 5 days for thiourea at 2% over the control in both seasons, respectively.

Table 1: Chemical and physical analysis of the soil

Depth	Physical characteristics									
	Particle size distribution				Texture	Bulk density g/cm³	Organic mater %	Soil moisture constant %		
	Coarse sand%	Fine sand %	Silt %	Clay %				F. C	W.P	A.W
0–30	50.13	29.50	9.02	11.35	Loamy sand	1.43	0.71	19.2	7.12	11.22
30–60	50.95	26.17	8.35	14.53		1.46	0.76	19.1	7.94	12.33
	Chemical characteristics									
	Soluble cations (meq/L)				pH	ECe (dS/m)	Soluble anions (meq/l)			
	Ca^{++}	Mg^{++}	Na^{+}	K^{+}			Cl^{-}	$^{-}Hco_3^{-}$	So_4^{-}	
0-30	15.33	17.25	13.10	1.54	7.34	3.50	6.15	3.01	25.69	
30-60	12.15	14.20	7.12	089	7.56	3.10	4.20	3.12	21.58	

Table 2: Effect of spraying with Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea treatments on time of flower bud opening in "Ein Shamer" apple trees

Treatments	Date of flower bud opening											
	Beginning		25%		50%		75%		End		Flowering period (No. of days)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	22/2	25/2	26/2	28/2	2/3	3/3	14/3	11/3	28/3	26/3	34	29
Dormex 4%	21/1	24/1	27/1	30/1	2/2	1/2	15/2	17/2	16/2	19/2	26	26
Mineral oil 5%	4/2	6/2	18/2	16/2	23/2	25/2	24/2	22/2	11/3	10/3	34	32
Potassium nitrate 8%	2/2	1/2	17/2	18/2	26/2	24/2	8/3	3/3	9/3	10/3	35	37
Calcium nitrate 8%	10/2	9/2	11/2	12/2	23/2	24/2	2/3	4/3	10/3	12/3	28	31
Thiourea 2%	5/2	6/2	21/2	18/2	25/2	26/2	5/3	6/3	10/3	11/3	33	33

Percentage of bud break

Data presented in Table 3 clearly show that all treatments gave a high percentage of flower bud break compared with the control. The maximum increases were recorded with Dormex 4% which recorded 89.11 and 88.24% in both seasons as compared with the control, respectively.

Yields and its components

Data in Table 3 indicated that all the tested substances increased apple yield and its components (fruit-setting, fruit weight, fruit size, and fruit number) as compared to the control trees. Such trend was true during the two studied seasons. The maximum increases were recorded with Dormex at 4% which recorded 21.90 and 18.66 for fruit-setting, 56.03 and 38.08% for fruit weight, 30.54 and 28.04% for fruit size, 56.81 and 50.19% for fruit number, and 62.06 and 38.32% for apple yield/tree in both seasons, respectively, over the control trees.

Chemical constituents of leaves

Total chlorophyll, total carbohydrates, and total protein

Data presented in Table 4 clearly showed that, during the two successive seasons of the study, all treatments increased the concentrations of leaf constituents (total chlorophyll, total carbohydrates, and total protein) as compared to the control. The best results were observed when apple trees were sprayed with Dormex at 4% which recorded 10.28 and 9.55% for total chlorophyll, 19.26 and 15.53% for total carbohydrates, and 24.56 and 14.77% for total protein in both seasons over the control plants, respectively.

Nitrogen, phosphorus, and potassium concentrations in leaves

Data presented in Table 4 revealed that leaves of apple trees contained higher concentrations of nitrogen, phosphorus, and potassium under foliar spray with any of the treatments than the control. The maximum increases were obtained when Dormex at 4% were used which recorded 24.56 and 14.77% for nitrogen, 30.00 and 25.00% for phosphorous, and 3.33 and 1.31 for potassium in both seasons, respectively, over the control trees.

Chemical constituents of fruits

Data of Tables 5 and 6 clearly showed that spraying apple trees with any of the tested substances significantly improved the chemical constituents of fruits T.S.S., total acidity, T.S.S./acid ratio, Vitamin C, water content %, total free amino acids, total carbohydrates, total sugars, reducing sugars, and total phenols as compared to the control trees. Such trend was true during the two seasons of the study. The maximum increases were recorded with Dormex at 4% which recorded 26.64 and 28.57% for T.S.S., 72.15 and 83.48% for T.S.S./acid ratio, 31.30 and 78.07% for Vitamin C, 7.97 and 8.01% for water content, 19.49 and 10.00% for total carbohydrates, 22.71 and 19.61% for total sugars, 30.09 and 33.27% for reducing sugars, and 28.00 and 21.46% for total free amino acids in both seasons, respectively, as compared to the control trees. On the other hand, the data in Table 5 also showed a marked decrease in total acidity and total phenols concentrations in fruits when trees were treated with any of the tested substances comparing with the control trees.

DISCUSSION

Spraying apple trees with any of the tested treatments (Dormex 4%, mineral oil 5%, potassium nitrate 8%, calcium nitrate 8%, and thiourea 2%) resulted in vigorous plant (tree) growth as well as high productivity with good fruit quality. Treatments increased the measured growth characters. This was due to the fact that these treatments resulted in more availability of macronutrients (N, K, and Ca) to plants. Enhancement of growth parameters with N application would be expected since nitrogen is of extreme importance to plants. It is a constituent of many important substances within plant cells such as protoplasm, in addition to amino acids, nucleic acids, protein, and chlorophylls [36]. The high levels of endogenous auxin and gibberellins were found in those plants sprayed with high N fertilizer [37], which encourage cell division and cell elongation, increases leaf number and produce a sufficient assimilation area for maximum rate of photosynthesis [38]. Moreover, Mengel and Kirkby [39] reported that the role of K in metabolism, growth, and yield formation can be characterized by two major functions: As an activator of enzymes and as K^- ions are very mobile within the plant as well as within a cell are transported through biological membranes with high rate and specificity. More than 60 enzymes are known to require K^+

Table 3: Effect of Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea treatments on the percentage of bud break, fruit setting, fruit weight (g), fruit size (CC³), total number of fruits/tree, and yield/tree in "Ein Shamer" apple trees

Treatments	Bud break %		Fruit set%		Fruit weight (g)		Fruit size (CC³)		Total number of fruits/tree		Yield per tree (kg)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	73.1	74.36	12.10	13.18	80.63	82.28	92.00	93.64	110.00	113.58	12.31	13.15
Dormex 4%	89.11	88.24	18.88	18.20	121.62	122.73	120.10	119.90	172.50	170.59	19.95	18.19
Mineral oil 5%	85.63	85.91	16.13	13.50	118.15	117.10	116.60	117.00	165.00	166.91	16.85	17.22
Potassium nitrate 8%	83.62	84.10	17.94	17.56	117.14	115.40	115.00	114.11	160.00	158.91	18.03	17.00
Calcium nitrate 8%	80.91	81.96	13.90	14.10	110.80	110.90	112.20	113.60	148.34	151.72	15.10	16.16
Thiourea 2%	78.20	79.10	12.61	13.28	108.29	106.90	110.20	109.80	123.34	132.11	10.86	11.66
L.S.D at 5%	2.26	2.46	1.35	1.38	1.10	1.11	1.36	1.43	2.79	2.81	1.05	1.04

Table 4: Effect of Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea treatments on chemical contents of leaves in "Ein Shamer" variety

Treatments	Total chlorophyll mg/g.f.w		Total carbohydrate mg/g.d.w		Total protein %		N %		P %		K %	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	1.75	1.78	74.29	77.13	9.68	10.56	1.55	1.69	0.20	0.20	1.50	1.52
Dormex 4%	1.96	1.95	88.60	89.11	12.06	12.12	1.93	1.94	0.26	0.25	1.55	1.54
Mineral oil 5%	1.90	1.91	85.01	86.30	11.43	11.31	1.83	1.81	0.22	0.23	1.53	1.52
Potassium nitrate 8%	1.92	1.93	85.06	85.15	11.31	11.37	1.81	1.82	0.23	0.22	1.51	1.52
Calcium nitrate 8%	1.88	1.85	82.98	83.10	11.06	11.12	1.77	1.78	0.23	0.22	1.50	1.52
Thiourea 2%	1.83	1.85	80.10	81.16	10.75	10.68	1.72	1.71	0.22	0.22	1.51	1.52
L.S.D at 5%	0.03	0.07	1.13	1.22	0.21	0.23	0.03	0.04	0.02	0.01	N.S	N.S

Table 5: Effect of Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea treatments on chemical fruit quality of "Ein Shamer" apple fruits

Treatments	TSS %		Acidity %		TSS/Acidity ratio		Vitamin C mg/100 ml juice	
	2016	2017	2016	2017	2016	2017	2016	2017
Control	10.36	10.50	1.06	1.07	9.77	9.81	1.15	1.14
Dormex 4%	13.12	13.50	0.78	0.75	16.82	18.00	1.51	1.52
Mineral oil 5%	12.65	12.50	0.82	0.81	15.42	15.43	1.49	1.47
Potassium nitrate 8%	12.25	12.20	0.91	0.87	13.46	14.02	1.47	1.45
Calcium nitrate 8%	12.10	12.16	0.88	0.89	13.75	13.66	1.44	1.45
Thiourea 2%	12.00	12.08	0.86	0.89	13.95	13.57	1.42	1.44
L.S.D at 5%	0.05	0.07	0.04	0.05	0.89	0.89	N.S	N.S

Table 6: Effect of Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea treatments on some chemical composition of "Ein Shamer" apple fruits

Treatments	Water content %		Total carbohydrates mg/F.W		Total sugars mg/g F.W		Reducing sugars mg/g F.W		Total free amino acids mg/g F.W		Total phenols mg/g F.W	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	75.20	76.10	139.50	142.55	83.61	84.10	53.50	54.10	1.75	1.77	0.48	0.51
Dormex 4%	81.20	82.20	166.7	169.00	102.60	100.60	69.60	72.10	2.24	2.15	0.26	0.27
Mineral oil 5%	80.00	81.20	162.10	159.50	92.10	94.20	64.61	65.15	2.20	2.17	0.37	0.38
Potassium nitrate 8%	77.15	78.10	152.10	153.30	94.60	93.30	62.20	60.20	2.00	2.10	0.39	0.39
Calcium nitrate 8%	77.10	79.51	151.20	152.50	92.60	93.30	60.15	60.25	1.95	1.97	0.40	0.35
Thiourea 2%	77.15	77.80	150.60	149.90	90.30	91.60	63.30	61.10	1.96	1.98	0.41	0.33
L.S.D at 5%	1.15	1.26	2.95	2.99	1.01	1.05	1.11	1.09	0.06	0.08	0.3	0.04

as an activator. The high mobility of K^+ on photosynthesis phloem loading and phloem transport …etc. Such important physiological roles enable potassium to perform its functions, which lead to an increase in various vegetative growth and yield. Moreover, the effect of hydrogen cyanamide and other substances used on nitrogen and protein content, it is clear from the present data that buds of apple trees contained higher concentrations of total nitrogen under foliar spray with any of the treatments than the control. These findings agreed with the suggestion of Kuroi [40], Yang *et al*. [41], they concluded that cyanide ion may play a role in inducing enzyme activity, promoting the translocation of stored reserves and the uptake of nitrogen with water for leading to bud break. Moreover, Miller and Hall [42] indicated that hydrogen cyanamide is directly involved in nitrogen metabolism and the production of protein. The degradation of cyanamide was demonstrated to occur through urea to other compounds and both are utilized in production of amino acids. Furthermore, Foot [43] found that hydrogen cyanamide penetrates the bud scales, gets absorbed in the buds, and initiates the processes leading to bud break. It is rapidly metabolized in the plant and helps in the synthesis of amino acids. Furthermore, the favorable effect of the used substances on date of flower bud opening may be due to their stimulation effect of natural gibberellin. In this connection, Luna *et al*. [44], Subha-Drabandhu [45] concluded that the induction of flowering could be correlated with a natural rise in gibberellin which promote flower formation in plants by either facilitating the formation of flowering hormone in the leaves or expressing it in the growing buds. Gibberellins also may be a primarily responsible for bolting which may be essential for the formation of the floral stimulus in leaves. Moreover, Subha-Drabandhu [45], Nashaat [46] reported that some different spray treatments may break dormancy by decreasing ABA content in buds.

The improving effect of Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea on yield and its components was mainly attributed to its positive action on enhancing growth parameters (Table 2) and photosynthetic pigments of plant leaves (Table 4). In this respect, Skene [47] reported that when a bud opens and attains the shape of a shoot, its tip acts as a strong sink for metabolites and thus being interception center for photosynthates and nutrients results in earlier start of the bloom. The promotive effect of Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea on chlorophyll formation might be attributed to their enhancing effect on the nutritional status of apple trees. Furthermore, the increase of total chlorophyll by spraying with N and K may be due to that N and K play an important role for stimulating chlorophyll synthesis enzymes which can be reflected on the formation of chlorophyll molecule. Moreover, the stimulating effect of Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea as foliar spray on total carbohydrates concentrations in leaves of sprayed trees may be directly or indirectly due to certain enzymes which activate the anabolic processes leading to the accumulation of these substances. The increase of all mentioned constituents by foliar N application may be due to that certain enzymes may be activated as a result of these treatments leading to the accumulation of such substances. The increase of macronutrients (N, P, and K) and protein content was supported by the results of El-Shewy *et al*. [22] on apple trees. In this connection, El-Shewy [48] found that there was a decrease in the nitrogen concentration of the woody tissues in the spring, particularly in the bark tissues of shoots. This might be attributed to the movement of nitrogenous compounds from the bark and wood to the developing flower buds and growing points. Moreover, the stimulating effect of Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea on physical characters (fruit weight and size) and chemical fruit characters (T.S.S., total acidity, Vitamin C, total carbohydrates, total sugars, reducing sugars, total free amino acids, and total phenols) was mainly attributed to its positive action on enhancing growth parameters (Table 2) and photosynthetic pigments of plant leaves (Table 4). Concerning the effect on T.S.S. and acidity in fruits, the results showed that all treatments increased T.S.S. significantly and decreased the total acidity. This increase in T.S.S. may be due to the increase in synthesis of carbohydrates and its accumulation in the developing fruits of the treated trees. In this connection, El-Shewy [49] mentioned that sugars represented about 70% of the T.S.S. in apple fruits and the increase in sugars lead to increase in T.S.S. He also added that the increase in cellular sap lead to decrease in acidity as a result of dilution of the organic acids. Moreover, Dame *et al*. [50], Mann and Singh [51], on pear, found that the increase in T.S.S. may be due to rapid conversion of starch, and the decrease in total acids content with advancement of ripening period may be due to that the acids are converted into soluble solids. The increase in Vitamin C may be due to that fruits synthesize ascorbic acid from hexose sugars and hence the adequate supply of these precursors would greatly depend on the photosynthetic activity [52]. In this connection, George *et al.* [53] suggested that water and nutrients may also be mobilized to the growing points at the expense of the developing fruits. Furthermore, Ahmed [54] found that large "Anna" apple fruits had significantly higher reducing and total sugars as well as lower starch and non-reducing sugars than small sized fruits. Moreover, Dame *et al.* [50] found that the increase in accumulation of T.S.S. and sugars during maturation has been related to accumulation of glucose, sucrose, and higher levels of fructose in "Bartlett" pear. On the other hand, Mann and Singh [51] found that the total phenols content (as tannic acid) decrease during ripening period. The reduction in phenolic content during ripening process may be attributed to its hydrolysis to different components such as sugars, acids, and other compounds [55].

CONCLUSION

Finally, from the results of the present investigation, it could be concluded that the application of Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea greatly increased growth and apple yield as well as improved apple quality and its chemical constituents. The constituents of these substances participate in the different metabolic processes which increased syntheses of chlorophyll, carbohydrates, total free amino acids, and absorption of essential nutrients so that the use of Dormex, mineral oil, potassium nitrate, calcium nitrate, and thiourea could increase apple productivity with high fruit quality.

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