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Evaluating the Effectiveness of Some Honey Bee Colony Products on the Growth and Productivity of Summer Squash Crops

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Abstract

This study was conducted at Al-Kawthar Farm, Dept. of Plant Protec., Fac. of Agric., Sohag Univ., through 2022 and 2023 years. This study aimed to identify the effect of honey, royal jelly and propolis as the most important products of the honey bee colony at the growth and productivity of summer squash. The obtained results indicated that honey bee products significant increase in plant growth and number of plant branches compared to distilled water only, no additives water or organic fertilization only in both seasons. Also, using honey bee products spraying on summer squash plant increased the fruit characters. Spraying summer squash plants withe (royal jelly + bee honey) for three times gave yield (7667 and 7833 kg/fadan) during the first and second years, respectively. Adding honey on the organic fertilize as a spray for 15 days gave, 75.00, 2.33, 2.66, 17.00, 7.33, 633.3 and 3933, plant height, branches No., fruit diameter, fruit length, fruits No., fruits weight, total fruits yield respectively in the year 2022. Adding honey to the organic fertilize as a spray for 15 days gave ,75.00 ,2.66, 17.00, 8.00, 733.3 and 4033 plant height, branches No., fruit diameter, fruit length, fruits No., fruits weight, total fruits yield respectively during 2023 year.

Key words: Honeybee products, Summer squash**,** Vegetative and Yi characters

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INTRODUCTION

Summer squash *Cucurbita pepo*, L. It is considered one of the most famous squash crops in Egypt. It is grown to cook its fruits, which are sold in local markets to increase the income of small farmers. Back to nature that the goal to protect our lives of pollution which effect negatively to our human health. Therefore, the idea we need that using nature products to improvement the plant growth without harm to our healthy such as honeybee products (honey, royal jelly and propolis). Honey is one of the secretary products of the pollinating, plant-biting lapping insect *Apis mellifera* (forager bee). During the formation of honey, bees depend on nectar that secreted by glandular tissue of flowers. Thus, an Honey is a product of the honey bee family *Apis mellifera*,L. to make honey, bees depend on the nectar secreted by plants from nectar-secreting glands. Therefore, one of the important components of honey is nectar, which is a plant product. Also, the plant sap secreted by piercing-sucking insects is in the form of small drops that fall on the surface of plant leaves to quickly collect to form honeydew, which the bees collect again and store in the form of honey known as honeydew. Some of the enzymes that bees use to ripen honey are of plant origin (Maurizio, 1975). Honey is also a supersaturated sugar solution, which consists of monosaccharides (fructose and glucose) and disaccharides (sucrose), in addition to other rare sugars (such as maltose and isomaltose) and polysaccharides (melisitose, raffinose, dextrin and etc.) (Anna *et al*., 2009). Honey also contains proteins including albumin, globulin, peptones, nucleoproteins and amides as well as amino acids (White, 1975). The proline, phenylalanine, tyrosine, lysine, arginine, glutamic acid, histidine and valine are the main amino acids found in 31 Spanish honeys from five different botanical origins (Hermosin *et al*. 2003). The pH of honey which averages 3.9 (3.2-4.5), is due to the fact that honey contains about 18 amino acids, in addition to many amino acids and mineral acids. Honey contains many enzymes such as glucose oxidase, catalase, incretase, acid phosphatase, and diastase (White, 1975). Honey includes mineral elements such as potassium, sodium, calcium, magnesium, chloride, phosphorus, sulfur and silica. (Terrab, *et al*., 2004). Honey also contains iron, copper and manganese. And small amounts of other elements such as aluminium, ion, boron, titanium, molybdenum, cobalt, zinc, lead, tin, antimony, chromium and nickel (Rashed and Soltan, 2004). Royal jelly is the food of the queen honey bee, her larvae, young worker larvae, and drones. Chemically, it consists of water (50% to 60%), proteins (18%), carbohydrates (15%), fats (3% to 6%), mineral salts (1.5%), and vitamins (Nagai and Inoue 2004). It also contains a good number of substances such as: the chemical compound 10 hydroxyl 2 decenoic acid (Caparica - Santos and Marcucci 2007), antibacterial protein (Fujiwara, *et al*., 1990), and fatty acids (Vucevic, *et al*., 2007). and peptides (Tokunaga *et al*., 2004). Royal jelly also showed significant improvement in recovery from damage caused by 5-fluorouracil (Suemaru, *et al*., 2008), and they reported that royal jelly had strong evidence of reproductive hormones and sex hormones. Some references have shown that there is an effect of honey bee products on plant growth, such as (Al-Mazini and Hassan 1990) who concluded that 0.05% royal jelly is highly recommended for use on plant leaves in cucumber production as a result of its tremendous impact on the crop and its products (Safiya H. Al-Hanafi 2008). Propolis is mainly composed of resin (50%), wax (30%), essential oils (10%), pollen (5%), and other organic compounds (5%) (Gomez-Caravaca, *et al*., 2006). It is an important product collected by bees gaining a lot of recognition and attracting public interest over the years. It is collected by bees from tree buds or other botanical sources and used to seal cracks or open spaces in hives. (Markham, *et al*., 1996). The study aimed to determine the effect of spraying with diluted concentrations of some honey bee products as a biostimulant on the growth and production of summer squash crops to obtain: Reducing the possible health hazard due to the nitrate accumulated in summer squash tissues.

1. Reducing environmental pollution.
2. Reducing summer squash production costs.

MATERIALS AND METHODS

The study was conducted at Al-Kawthar Farm, Department of Plant Protection, Faculty of Agriculture, Sohag University, during the 2022 and 2023 seasons for the purpose of studying the effect of some honey products (honey - royal jelly - propolis - a mixture of honey and royal jelly) at a concentration of 0.08%) on the growth and production of summer squash and its effectiveness under Environmental conditions in Sohag Governorate.

1. Preparation of honey products:

1.1. Honey preparation:

Honey solution prepared by adding one litter of distilled water to 80 gm. of stored honey using a plastic gar (0.08 % concentration), this concentration was sprayed directly after preparation on summer squash plant (Safia H. El-Hanafy, 2008).

1.2. Royal jelly preparation:

After collected royal jelly from honeybee colonies: stored at 0 °C in a refrigerator until using in the spraying. To prepare rate 0.08 % of royal jelly was added 8 grams of royal jelly to 100 cm^3 of distilled water in each time of spray on summer squash plants under El- kawsur conditions, (El-Maziny and Hassan 1990).

1.3. Propolis extracts preparation:

Propolis was collected using different techniques from honey bee colonies from the private apiary, during the year 2021. Propolis was extracted by soaking at room temperature 10 grams of raw Egyptian propolis using a sensitive balance. The propolis was then cut into small pieces about 5 - 10 mm in size and placed in a conical flask, and 100 ml of solvent (0.08% v/v ethanol) was added. Ethanol was poured into the conical flask to submerge the propolis. The vial was covered with aluminum foil and held securely with rubber bands. To extract the active ingredient in the mixture, the mixture was shaken vigorously for half an hour and left for 7 days (Krell 1996, Iidenize et al. 2004) (Obasa et al. 2007). The resulting extract was filtered through Whatman No.1 filter paper into a conical flask. Evaporate the ethanol in a light brown filter overnight at room temperature. This extract was diluted in water to a final concentration of 80% (ethanolic propolis extract).

1.4. Mixture preparation of honey and royal jelly:

To preparation mixture of honey & royal jelly, we add 10 grams of royal jelly to 1 kg of bee honey, to prepare 0.08 % of the mixture and then taking 80 grams of this mixture were added to 1 liter of distilled water cooler and filtered using directly as spray on summer squash plants.

2. Summer squash sprays with distilled water only (control):

Summer squash sprays with distilled water only, grown organically (chicken manure at rate 25 ton/fed.) and grown with recommended chemical NPK. Moreover, summer squash grown organically plus spraying with the three honey products as foliar sprays were applied once after 15 days, twice after 15 and 30 days and three times after 15, 30 and 40 days.

3. Organic fertilizer:

Organic fertilizers from chicken farm waste were added to the soil. Nitrogen chemical fertilizers were added at a rate of 100 kg in the form of ammonium nitrate (33.5% N) on three equal doses 15, 30 and 45 days after planting. Phosphorous fertilizers such as calcium superphosphate (15.5% P_2O_5) were added during soil preparation as recommended at a rate of 45 kg P_2O_5/fadan. Potassium fertilizer was added in two equal batches, such as potassium sulfate (50% K_2O), the first with the first irrigation and the second with flowering and fruiting, at a rate of 50 kg K_2O/fadan.

4. Spraying applications:

The experiments were applied three times; the first was after 15 days after the complete germination, the second after 30 days and the third after 45 days later.

5. Soil analysis:

10 samples of the experimental soil were taken randomly before planting, air-dried, ground, and sieved to determine the physical and chemical characteristics of the experimental site as in Table (1).

Table (1): Some physiochemical properties of the experimental soil.

Physical properties		
Texture class	Clay %	13.44
	Silt %	39.00
	Sand %	47.56
	PH	8.50
	EC mmhos/cm at 25 ^{o}C	0.80
Chemical properties		
Soluble cations and anions (meq/100 g soil)	Ca^{++}	1.80
	Mg^{++}	0.80
	Na^{+}	3.55
	K^{+}	1.28
	CO_3^{-}	--
	$CaCO_3$%	4.00
	HCO_3^{-}	0.40
	Cl^{-}	1.00
	$SO_4^{=}$	6.03
Concentration of available nutrients in ppm	N	15.00
	P	20.00
	K	924.00

RCBD with three replicates was used in this experiment. Each replicate contained fifteen plots as follow:

1. Water spraying only
2. Organic fertilizing only
3. Recommended dose of NPK only
4. Organic fertilizing + Royal jelly spraying at 15 days
5. Organic fertilizing + Royal jelly spraying at 15 and 30 days
6. Organic fertilizing + Royal jelly spraying at 15,30 and 45days
7. Organic fertilizing + Honey spraying at 15 days
8. Organic fertilizing + Honey spraying at 15 and 30 days
9. Organic fertilizing + Honey spraying at 15,30 and 45days
10. Organic fertilizing + Royal jelly+ Honey spraying at 15days
11. Organic fertilizing + Royal jelly+ Honey spraying at 15 and 30 days
12. Organic fertilizing + Royal jelly+ Honey spraying at 15, 30 and 45days
13. Organic fertilizing + Propolis spraying at 15 days
14. Organic fertilizing + Propolis spraying at 15 and 30 days
15. Organic fertilizing + Propolis spraying at 15, 30 and 45days

The area of each piece is 10.5 m^2. Each is 3.5 meters long and 3 meters wide. The experimental site was prepared and planting took place on March 13 and 14 in the first and second seasons, respectively, by planting two seeds in each hole. Growing plants were thinned to one plant just before the first watering. All other agricultural practices for cucumber production other than the applied treatments were carried out in accordance with the recommendations of the Egyptian Ministry of Agriculture. 10 plants (Summer Squash Crop) were randomly chosen in each plot to determine the flowing characters:

1. Length of main stem were recorded at the end of growing seasons.
2. Recorded No. of branches/plant at the end of growing seasons.

Fruits were collected every two days, and twenty fruits were taken from each plot in fifths picking to determine the characteristics of the following fruits:

1. Fruit length (cm.) (10 plants were randomly chosen).
2. Fruit diameter (cm.) (10 plants were randomly chosen).
3. Also, yield and its components were recorded as follow:
4. No. of fruits per plant.
5. Weight of fruits per plant.
6. Total fruits yield kg per fadan.

6. Statistical analysis: -

Data obtained during the two study seasons were statistically analyzed and the means used were compared using Duncan's multiple range tests (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Vegetative and yield characters:

1. **Plant height (cm):**

Data presented in Tables (2 and 3) clearly show that spraying summer squash plants with honey bee products was significantly increased plant height compared to distilled water or organic fertilization only in both seasons. Also, fertilizing summer squash with organic or chemical fertilization was significantly increased plant height compared with plant treated with distilled water in both seasons. Fertilizing summer squash plants with NPK gave the tallest plants (118.3 cm) followed by spraying with mixture bee honey and royal jelly for three times(113.3cm) compared to the shortest one (60.0 cm) obtained by spraying with distilled water in both seasons.

2. **Number of branches/plant:**

The results shown in Tables 2 and 3 clearly reveal this all studied treatments a significant increase in the number of branches/plant compared to spraying with distilled water only. These results remained at the same level in both seasons. The highest number of branches/plant was achieved when spraying with royal jelly mixed with honey and applying the recommended dose of NPK fertilization followed by a mixture of royal jelly + honey two and three times in both seasons.

3. **Fruit diameter (cm):**

Data in Tables (2 and 3) indicated that all studied treatments significantly influenced fruit diameter compared with spraying for distilled water in both seasons. Fertilizing summer squash with recommended dose of NPK resulted in the highest values of this character followed by spraying with mixture of (Royal jelly + Bee honey) three times compared to all other treatments. These results finding held well in both seasons.

4. Fruit length (cm):

The results shown in Tables 2 and 3 showed a significant improvement in fruit length with organic or chemical fertilizers in the presence or absence of spraying various honey products compared to spraying with distilled water in both seasons. The highest values of fruit length were estimated by spraying with honey for three times. The same trend was obtained by treating with the recommended dose of NPK fertilizer.

5. **Fruits number/plant:**

Data presented in Tables (2 and 3) show that fertilizing summer squash plants with chemical or organic fertilizers in presence or absence of different honey bee products treatments significantly increased fruits number/plant compared to spraying regarding to honey bee products, spraying with royal jelly plus honey three times or recommended NPK produced the highest values (12.67) compared to all studied treatments in both seasons.

5.1. Fruits weight (g): The values of fruits weight are presented in Tables (2 and 3) indicated that all studied treatments significantly improved this character compared to control (spraying with distilled water) in both seasons. Appling recommended dose of NPK gave the highest values in the first season, while in the second season the highest values were achieved by spraying with royal jelly plus honey three times compared to all studied treatments.

5.2. Total fruits yield (Kg/fadan.): The clear data in Tables 2 and 3 demonstrate this all studied treatments were significantly increased of total fruits yield compared with treatments, spraying with distilled water in both seasons. Spraying summer squash plants with (royal jelly + bee honey) for three times gave yield (7667 and 7833 Kg/fadan) in the first and the second seasons respectively. This result exceeded all treatments studied except the recommended concentration NPK in both seasons. This finding may be due to the increments induced number of branches and fruit characters previously discussed. Honey, propolis, and royal jelly are the products of the bee colony, and they are nutritional and therapeutic products of great value. All of them are important not only for their nutritional properties but also for their functional and biological properties, their antioxidant, anti-inflammatory, antibacterial,

antiviral, anti-ulcer properties and also the ability to inhibit enzymatic activity. The results show that, these increments in vegetative growth and yield characteristics may be attributed to the highly nutritional and hormonal status of honey bee products. Honey bee products contain at least 17 amino acids, including the 8 essential oiles, which are essential for growth and yield. Beside its tremendous effects on increasing summer squash yield, honey bee products is safe to be used because it's natural material which has no harmful effect on plant or human. These results are in line with those found by Nation and Robinson (1971), El-Maziny and Hassan (1990), Safia H. El-Hanafy (2008) and El-Shaikh (2010).

Table (2) Vegetative and yield characters of summer squash plants as affected by application of fertilizing treatments during 2022.

Characters Treatments	Plant height (cm)	Branches No./plant	Fruit diameter (cm)	Fruit length (cm)	Fruits No./plant	Fruits weight (g)	Total fruits yield (Kg/fadan)
1. Water spraying only	60.00j	2.33e	2.43i	15.33g	5.66g	483.3k	2700l
2.Organic fertilizing only	73.33i	2.66de	2.86ef	17.67ef	8.33e	783.3gh	4300j
3.Recommended dose of NPK only	118.3a	4.66a	3.53a	21.00ab	12.67a	1233.0a	8700a
4.Organic fertilizing + Royal jelly spraying at 15 days	73.00i	3.66bc	2.83fg	17.67ef	9.66cd	850.0 efg	5733g
5.Organic fertilizing + Royal jelly spraying at 15 and 30 days	85.00f	3.66bc	2.96de	19.33cd	11.00b	873.3ef	6073ef
6.Organic fertilizing + Royal jelly spraying at 15,30 and 45days	93.00d	4.33ab	3.20c	20.33bc	12.00a	906.7de	62.33de
7.Organic fertilizing + Bee honey spraying at 15 days	75.00hi	2.33e	2.66h	17.00f	7.33f	633.3j	3933k
8.Organic fertilizing + Bee honey spraying at 15 and 30 days	81.00g	3.00cde	2.80fg	17.67ef	8.66e	733.3hi	4567i
9.Organic fertilizing + Bee honey spraying at 15,30 and 45days	88.00e	3.66bc	2.86ef	18.67de	9.66cd	806.7fg	5933fg
10.Organic fertilizing + Royal jelly + Bee honey spraying at 15, 30 and 45days	93.00d	3.66bc	2.90ef	18.67de	10.33bc	950.0cd	6433d
11.Organic fertilizing + Royal jelly + Bee honey spraying at 15, 30 and 45days	96.00c	4.33ab	3.03d	20.33bc	12.00a	983.3c	6933c
12.Organic fertilizing + Royal jelly + Bee honey spraying at 15, 30 and 45days	113.00b	4.66a	3.36b	21.67a	12.67a	1133.0b	7667b
13.Organic fertilizing + Propolis spraying at 15 days	76.00h	2.66de	2.73gh	17.33f	8.33e	650.0j	3900k
14.Organic fertilizing + Propolis spraying at 15 and 30 days	83.00fg	3.33cd	2.90ef	17.67ef	9.00de	683.3ig	4133jk
15.Organic fertilizing + Propolis spraying at 15, 30 and 45days	89.00e	3.66bc	3.03d	19.33cd	10.00c	721.7hi	5067h

Means followed by the same letters are not significantly different from each other at 0.5% level.

Table (3) Vegetative and yield characters of summer squash plants as affected by application of fertilizing treatments during 2023.

Characters Treatments	Plant height (cm)	Branches No./ plant	Fruit diameter (cm)	Fruit length (cm)	Fruits No./ plant	Fruits weight (g)	Total fruits yield (Kg/fed)
1.Water spraying only	60.00h	2.00f	2.467h	15.67h	6.00i	473.3j	2787k
2.Organic fertilizing only	76.67fg	2.33f	2.967de	17.67efg	8.33gh	733.3gh	4167li
3.Recommended dose of NPK only	118.30a	5.00a	3.50a	21.67a	12.67a	1133.3b	8767a
4.Organic fertilizing + Royal jelly spraying at 15 days	73.33g	3.33de	2.767fg	17.67efg	9.66def	826.7e	5633f
5.Organic fertilizing + Royal jelly spraying at 15 and 30 days	83.33ef	3.66cd	3.03cd	19.33c	11.00bc	886.7d	6100e
6.Organic fertilizing + Royal jelly spraying at 15,30 and 45days	91.67d	4.33 abc	3.16c	20.33b	11.33b	986.7c	6833j
7.Organic fertilizing + Honey spraying at 15 days	75.00g	2.66ef	2.66g	17.00Fg	8.00h	733.3gh	4033j
8.Organic fertilizing + Honey spraying at 15 and 30 days	83.33ef	3.33de	2.86ef	18.00def	8.66fgh	800.0ef	4500h
9.Organic fertilizing + Honey spraying at 15,30 and 45days	91.67d	3.66cd	2.96de	19.33c	10.00 cde	896.7d	5933e
10.Organic fertilizing + Royal jelly+ Honey spraying at 15, 30 and 45days	91.67d	4.00abc	2.86ef	19.00cd	10.33 bcde	933.3d	6633d
11.Organic fertilizing + Royal jelly+ Honey spraying at 15, 30 and 45days	98.33c	4.33abc	3.10cd	20.67ab	11.33b	1000c	7083c
12.Organic fertilizing + Royal jelly+ Honey spraying at 15, 30 and 45days	111.7b	4.66ab	3.30b	21.67a	12.67a	1200a	7833b
13.Organic fertilizing + Propolis spraying at 15 days	78.33fg	2.66ef	2.70g	16.67g	8.33gh	683.3i	4000j
14.Organic fertilizing + Propolis spraying at 15 and 30 days	87.00de	3.33de	2.86ef	17.67efg	9.33efg	7.00hi	4367hi
15.Organic fertilizing + Propolis spraying at 15, 30 and 45days	91.67d	3.66cd	2.96de	18.67 cde	10.67 bcd	766.7gh	4833g

Means followed by the same letters are not significantly different from each other at 0.5% level.

CONCLUSION

The study was conducted for the purpose of studying the effect of some honey products (honey - royal jelly - propolis - a mixture of honey and royal jelly) at a concentration of 0.08%) on the growth and production of summer squash and its effectiveness under Environmental conditions in Sohag Governorate. Spraying summer squash plants with (royal jelly + bee honey) for three times gave yield (7667 and 7833 Kg/fadan) in the first and the second seasons respectively. Therefore, we recommend using this mixture at this rate to obtain the highest yield of summer squash plants while achieving the least use of chemicals.

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