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Response of Newly Introduced Tomato Cultivars to Different Levels of Potassium Fertilizer Under Controlled Environment Condition.

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Abstract: **The experiment was carried out during growing season (2016-2017) at station of greenhouses, AL-muthanna university- collage of agriculture- second research station (Al-Bander) to study the response of introduced tomato cultivars to different concentrations of potassium under protected agriculture conditions. The research included three cultivars (Pusa ruby - Arka vikash- Arka Alok) and three levels of Potassium Fertilizer (90-180-270 kg/ha^{-1}). The Randomized Complete Block Design with factorial experiment (RCBD) with three replicates. The results showed the superiority of Arka Alok variety over others in plant height 121.76 cm, fruit width 6.82 cm, fruit length 4.23 cm, average fruit weight 130.61g, leaf area 129.5 cm^2, the yield per plant 2.16 kg. The potassium level (270 Kg/ha^{-1}) was also significantly higher in plant height 118.79 cm, fruit width 5.477 cm, fruit length 3.536 cm, 84.60 g, leaf area 127.3 cm^2, TSS 4.97 and chlorophyll content 406.89 mg.m^2 and yield per plant 2.16 kg. While the interaction showed significant difference (Arka Alok × 270 Kg.ha^{-1}) in fruit length was 4.24 cm, chlorophyll content was 374.91 mg. m^2 and the yield per plant was 2.82 kg. plant^{-1}**

Keyword: **Tomato, Genotypes, Potassium levels, Growth, Yield.**

I. INTRODUCTION

Tomato is a plant of the *Solanum melongena* L., one of the important vegetable crops in the world and Iraq. The importance of this crop lies in the nutritional value of its fruits and the abundance and diversity of its consumption, whether fresh or cooked orn the form of processed food products [1]. The cultivated area in Iraq in 2010 was estimated at 53195 ha with a productivity of 19046.5 kg / ha compared to the average area of A global amount of 4336505 hectares and productivity 33587.5 kg/ha [2] and can increase production by following some scientific methods as the entry of new varieties and to add some of the necessary elements for their growth. Nutrients elements play an important role in growth and development of plants and their presence in concentrations less than the need of the plant reduces their growth, so filling the plant's need of elements is necessary [3]. Potassium plays an important role in the plant for its effective role in regulating the osmotic pressure inside the plant cells and increases the plant's ability to retain water and its role in opening and closing the stomata [4].

The foliar applications of fertilizers improved plant growth and encouraged the introduced of modern growth as well as increased dry matter in the plant due to the accumulation of carbohydrates through the activity of photosynthesis in the vegetative parts of the tomato, [5]. The spraying of potassium on tomato plants growing in the greenhouse are significantly increased the yield per plant, [6]. The average of potassium concentration in plant tissues it will around (2–6 %) of dry plant weight, while the total of potassium present in soil in different amount ranging from to (0.1- 4%) However, the plant's uptake of this element in the soil does not exceed 1%, [7]. Generally most of Iraq's soil responds to the addition of potash fertilizers [8].

The addition of potassium fertilizer to plants which improves the absorption of nitrogen and thus helps to increase the efficiency of the use of nitrogen, and also plays a role in plants, such as turgor pressure of cells, activating enzymes, improving the efficiency of photosynthesis, and the formation and transfer of carbohydrates, sugars and nitrate reduction, and improves the quality of fruits and helps plant to tolerate the water and soil salinity and tolerate drought and frost resistance, so the synthesis of proteins needs a high level of potassium, which is very important in the process of photosynthesis and transfer of the products of representation of leaves to the rest of the plant parts, and encourages the growth of roots and increases resistance diseases, and helps transfer nitrates on form KNO_3 from roots to leaves in the plant [9].

II. Materials and methods:

A greenhouse experiment was carried out during growing season 2016-2017 in AL-muthanna University College of agriculture- second research station (Al-Bander), to study the effect of Potassium Fertilizer on the traits of growth and yield of tomato under protected greenhouses conditions. Seed were sown on 15th September and transplanting was done in 10th October 2016 after appearance fourth real leaves, The space between rows was 70 cm; transplanting space between plants was 40 cm, each experimental unit contained 10 plants, the cultivars are (Pusa ruby – Arka vikash- Arka Alok),

These elite cultivars have been taken from India. Some of the important characteristics of these cultivars are described below [10].

1. Pusa Ruby**:** Variety is released by IARI (Indian Agriculture Research Instiitute), New Delhi. It is an early growing cultivar, fruits a have yellow stem end, slightly furrowed with uniform ripening. Variety is suitable for sowing both in spring-summer and autumn-winter seasons. Average yield is 32.5 t/ha. It is suitable for table as well as processing purpose.
2. Arka Vikas (Sel 22): Variety released by IIHR (Indian Institute of Horticulture Research), Bangalore. Plants are semi-determinate with dark green foliage. Fruits oblate, medium large (80-90 g), with light green shoulder, suitable for table purpose. Tolerant to heat and moisture stress. Crop is cultivated in Kharif/Rabi season and matures in 140 days. Average yield is 35-40 t/ha.
3. Arka Alok (BER-5): Variety released by IIHR, Bangalore. Plants are determinate. Fruits are large (120g) square round with light green shoulder. This variety is suitable for table purpose and is resistant to bacterial wilt. Crop is cultivated in Kharif/Rabi season and matures in 130 days. Average yield is 46 t/ha.

Addition of Potassium fertilizer to the soil in the form of potassium sulphate (41.5%) and at three levels (90-180-270 kg.ha^{-1}) and the control treatment was considered to add the recommendation of fertilizer in Iraq (180 kg. ha^{-1}), [9].

III. Soil Properties

To determine some of the physical and chemical properties facilities of soil and Water Department laboratories, collage of agriculture, Al Muthanna University was utilized. (Table.1) presents a view of soil properties.

IV. Experimental Design

The experiment was carried out according to randomized complete block design, with three replicates, and the mean was measured according to the least significant difference L.S.D at 0.05 [11].

Table 1: Some physical and chemical properties of the experimental soil.

Properties	Unit	results
ECe	ds.m^{-1}	3.0
pH	-	7.8
OM	gm.kg^{-1}	8.0
N	mg.kg^{-1}	38.1
P	mg.kg^{-1}	26
K	mg.kg^{-1}	110
Sand	gm.kg^{-1}	260
Silt	gm.kg^{-1}	600
Clay	gm.kg^{-1}	140
Soil texture	Silty loam	

The following properties measurements were taken:

1. Plant height (cm): Six plants were taken randomly from middle row from each plot at blooming stage measurements were starting from the crown area to the end of the main stem using measuring tape.
2. Chlorophyll content (mg.m^{-2}): Evaluate the total chlorophyll content of the leaves by a device Chlorophyll meter (Spad 502), for ten plants randomly taken from the midline of each experimental unit, and by the following formula, [12].

$$Ch= -80.05+10.40*(SPAD-502)$$

3. Leaf area (cm^2): Ten leaves of each plant in experimental unit were taken randomly from middle line. The leaves area of 100 leaves was studied from six plants using Cl-202 Laser Area meter.
4. Total soluble solids (TSS): A quarter part (1/4) of each of the 10 fruits chosen at random in third or fourth picking was used to make a representative sample. The fruit pieces were macerated in a pestle and mortar and juice was extracted. The T**SS** percentage was recorded under room temperature (25^{0}C) with the help of 'Erma Hand Refractometer' by putting 2-3 drops of juice on the prism and taking the reading. The values recorded were expressed as *per cent* of juice [13].
5. Number Fruits per plant: Total number of fruits harvested from all the pickings was pooled and the average number of fruits was calculated.
6. Fruit size (length & width) (cm): The length of fruit was measured in centimeters (cm) from the base of the calyx to tip of fruit with the help of vernier calipers. Diameter of the fruit was measured in centimeters (cm) with the help of vernier calipers at the center (equatorial length) of the fruit.

7. Average fruit weight (g): Well developed individual fruit weight for five fruits was recorded in grams by weighing on a sensitive balance.
8. Fruit yield per plant (kg.plant^{-1}): Fruit yield was determined by adding the total fruit weight over all the pickings from each reference plant and expressed in kilograms (kg).

V. Results and Discussion

1. *Genotypic Variations for Growth and Yield Traits:*

The results of the statistical analysis showed significant differences between the genotypes of most traits of growth and yield. The superiority of the Arka Alok genotype was significantly higher in plant height, which was 121.76 cm, fruit width was 6.82 cm, fruit length was 4.23 cm, fruit weight was 130.61 g, **a**nd leaf area was 129.5 cm^2 and yield per plant 2.12 kg.plant^{-1} (Table 2). This is due to the fact the Arka Alok is one of the elite cultivars and has outperformed all other cultivars in other studies as well [14]. Increasing leaf area and chlorophyll content could be responsible for increased carbon gain as a source and sent to the sink fruits, so the components of the crop and fruits increase which ultimately increase the yield per plant.

Table (2) Effect of genotypes in some traits of growth and yield.

genotypes	Plant height (cm)	Chlorophyll content (mg.m^{-2})	Leaf area (cm^2)	Tss	No. of fruits per plant	Fruit size		Average fruit weight (g)	Fruit yield per plant (Kg)
						Fruit length (cm)	Fruit width (cm)		
Pusa ruby	108.90	٤٠٧.٦١	١١٦.٧	4.518	28.61	3.238	٥.٠٧	79.17	٢.٠٩٤
Arka vikash	114.65	٣٦٠.٧٠	١١٣.٥	5.136	45.89	2.892	4.04	38.59	١.٧٤٧
Arka alok	121.76	٣٦٨.٤٠	١٢٩.٥	4.896	16.39	4.239	6.82	130.61	٢.١١٥
L.S.D@0.05	٤.٤٩	ns	٨.٣٦	ns	٣.٦٦١	٠.١٤٠	٠.١٧	٤.٤٩	٠.٢٣٤

2. *Effect of add potassium Fertilizer in some traits of growth, yield and its components.*

The results showed significant differences between potassium levels for all growth characteristics. The level of potassium (٢٧٠ kg. h^{-1}) was significantly higher in plant height, which was 118.79 cm, fruit width was 5.48 cm, fruit length was 3.54 cm, fruit weight was 84.60 g, Leaf area 127.26 cm2, Tss 4.97, No. fruit per plant was 32.15 per plant, chlorophyll content 407.61 mg.m^{-2} and yield per plant 2.16 kg.plant^{-1} (Table 3).This result was accepted with [15] in a studied on potatoes that confirmed the effect of potassium in the regulation of biological processes such as cell division and cell membrane permeability, which led to increased vegetative growth, and this reflected a positive response to increase the yield per plant. It is also due to the biological role of potassium element in the synthesis of carbohydrates and protein. It also improves the water system of the plant and increases its ability to resist drought and disease [9].

Table (3) Effect level of potassium in some traits of growth, yield and its components.

Level of Potassium	Plant height (cm)	Chlorophyll content (mg/m^2)	Leaf area (cm^2)	Tss	No. of fruits per plant	Fruit size		Average fruit weight (g)	Fruit yield per plant (Kg)
						Fruit length (cm)	Fruit width (cm)		
٩٠ Kg.ha^{-1}	109.10	٣٤٠.٥٣	١١٠.١١	4.66	24.12	3.10	5.00	78.21	١.٧٨
180 Kg.ha^{-1}	111.41	٣٥٠.٨٢	١١٢.٤٥	4.74	28.44	3.38	5.16	80.98	١.٨٢
٢٧٠ Kg.ha^{-1}	118.79	٤٠٦.٩٨	١٢٧.٢٦	4.96	32.15	3.54	5.48	84.60	٢.١٦
L.S.D@0.05	٣.٦٧	١.٩٠	٦.٨٣	٠.١٩٧	٢.٩٨	٠.١١٤	٠.١٤١	١.٩٤	٠.١٩١

3. *Effect the interaction between the genotypes and potassium fertilizer in some of the characteristics of growth, yield and its components.*

The results in Table (4) showed no significant differences between the interaction of genotypes and potassium fertilizer for some growth characteristics, such as fruit number, TSS, fruit width, fruit weight and leaf area. The interaction, (Pusa ruby x ٢٧٠ Kg.ha^{-1}), was higher in plant height at 120.21 cm, This is due to the role of potassium in the process of cell division and expansion through its role in providing an optimal expansion of the cellular wall that is necessary for growth and division [16] all of which positively reflected in plant height. While the interaction (Arka Alok × ٢٧٠ Kg.ha^{-1}) in fruit length was 4.24 cm, chlorophyll content was 374.91 mg.m^{-2} and the yield per plant was 2.82 kg.plant^{-1}, that is may be due to increase the growth and yield characteristics in table (2 and 3) and the effect of potassium in representation of protein and carbohydrate transfer [9] and thus increase the yield in plant. This may be due to the interplay between the Arka Alok genotype and fertilization. This indicates the genotypes response to the environmental

conditions in the experimental area and the fertilization treatment that were suitable to give the perfect concentration for producing a superiority yield per plant.

Table (4): Effect of interaction between genotypes and potassium in some traits of growth, yield and its components.

Genotypes	Level of K ($Kg.ha^{-1}$)	Plant height (cm)	Chlorophyll content (mg/m^2)	Leaf area (cm^2)	Tss	No. of fruits per plant	Fruit size		Average fruit weight (g)	Fruit yield per plant (Kg)
							Fruit length (cm)	Fruit width (cm)		
Pusa ruby	٩٠	103.10	٢٩٥.٤٩	126.0	4.6	25.2	2.51	6.99	136.0	1.98
	180	112.45	٣١٦.٢٩	125.3	4.7	27.1	2.84	7.34	125.0	2.00
	٢٧٠	120.21	٣٢٣.٢٦	123.6	4.66	27.2	3.04	7.10	140.0	2.10
Arka vikash	٩٠	103.10	٢٩٤.٣٥	130.0	4.63	26.3	2.49	7.20	142.0	2.15
	180	118.68	٣٢٦.٧٩	131.0	4.55	28.0	2.85	6.52	126.0	2.09
	٢٧٠	124.85	٣٣٨.٥٥	130.5	4.67	28.3	4.2٤	6.25	130.0	2.00
Arka alok	٩٠	112.54	٣١٦.٦١	129.0	4.55	25.4	2.93	7.00	122.0	2.25
	180	114.69	٣٤٨.٧٤	127.5	4.66	26.2	3.44	6.98	134.0	2.10
	٢٧٠	116.84	٣٧٤.٩١	124.9	4.62	27.0	4.24	6.88	147.0	2.82
L.S.D@0.05		٢.١٠	١.٨٨	ns	ns	ns	١.٢١	ns	ns	٠.٢١

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