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EFFECT OF MEPIQUAT CHLORIDE AND POTASSIUM SOURCES ON GROWTH AND YIELD OF PATATO PLANTS (*SOLANUM TUBEROSUM* L.)

[3]

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ABSTRACT

In this study, Two field experiments were conducted in Ourabi operation Farm, Cairo-Ismaellia desert road at Kalubia Governorate. The experiment was carried out during the two seasons of 2013/2014 and 2015/2016, to investigate the effect of plant growth regulator (Mepiquat chloride) with three different potassium fertilizers sources [chemical potassium (KC), foliar potassium (KF) and rock potassium (KR)] on growth development and total yield in potato plants (*Solanum tuberosum* L. cv. Spunta) .

Chemical potassium (control) with / without Mepiquat chloride achieved better plant height, no. of stem and leaf area/plant. Rock potassium with mepiquat chloride obtained the highest productivity of fresh and dry weights, total tuber yield and yield components (weight of tubers, size of tubers, diameter of tubers and number of tubers) following by foliar potassium with mepiquat chloride compared with control treatment.

Keywords: Potato, *Solanum tuberosum*, Rock potassium, Mepiquat chloride, Foliar potassium, Chemical potassium**.**

INTRODUCTION

Potato (*Solanum tuberosum* L. cv. Spunta) is one of the most widely grown tuber crop in the world and contributes immensely to human nutrition and food security **(Jackson, 1999)**. Potato has high carbohydrate and low fat content that makes it an excellent energy source for human on sumption **(Dean, 1994)**. Potato contains high quality proteins and a substantial amount of essential vitamins, minerals, high carbohydrate content, calcium, potassium and vitamin **(Blagoeva et al 2004).**

Potassium is particularly important in helping plants adapt to environmental stress such as drought, winter hardiness, tolerance to diseases, insect pests and frost damage **(Brady and Weil, 2002)**. Moreover, It is also involved in activation of enzymes important to energy utilization, starch synthesis, N metabolism, and respiration. These enzymes are abundant in the meristematic tissue at the growing points (like sprouting tuber eyes) where cells are dividing and primary tissues are formed **(Havlin et al 2005).** K is an essential nutrient for all plants and has a major effect upon growth and yield of potatoes as well as the general health and vigor of the crop **(Abd EL-Latif et al 2011).** Potassium is an essential nutrient for growth of the crops, including potatoes. Its role is well documented in photosynthesis, increasing enzyme activity, improving synthesis of protein, carbohydrates and fats, translocation of photosynthetate resulting higher productivity of potato tubers **(Daniel et al 2016)**

Mepiquat chloride appears to be acting as an anti-plant growth hormone agent to stunt growth through some reaction or interference with the effects of plant growth hormones. Thus enhances early plant growth by adding growth regulating agents to the soil around the seeds and/or to the plant during its vegetative growth period to compensate for the interference later in the cycle by mepiquat chloride, and applying mepiquat chloride to the plant at a rate sufficient to stunt vegetative

growth. This combination of steps enhances early plant growth and plant mass (particularly root and stem growth) which translates into enhanced set and retention. Thereafter, further vegetative growth is retarded by mepiquat chloride in favor of potato (tubers) production, because the plant growth was accelerated early in the life cycle, however, the plant assimilates larger quantities of nutrients which provides the plant immune system with a higher level of ability to resist diseases, recover from insect attack, and endure drought conditions **(Clark et al 1998).** However, **Prakash et al (2001)** investigated the effect of growth retardant (mepiquat chloride at 500 and 1000 ppm) on growth parameters and tuber yield in potato cultivars Kufri Chandrmukhi and HPS-II/67. Leaf area decreased by growth retardant treatment. An increase in the concentration of growth retardant resulted in an increase in specific leaf weight (SLW). Moreover, **Vyakarnahal et al (2010)** studied the effect of growth retardant and methods of application on growth and yield of potato crop in cultivar Kufri Pukhraj. Mepiquat Chloride at 100 ppm along with the control were used with four application methods viz., tuber dipping, foliar spray at 30 days after planting, foliar spray at 45 days after planting, foliar spray at 30 and 45 days after planting and a control treatment. Mepiquat chloride improved establishment and growth parameters (plant height, number of stems, leaf area and total dry weight). Mepiquat chloride 100 ppm foliar sprayed at 30 and 45 days after planting proved to be the most effective. The tubers yield under this treatment was significantly superior over the control (water dip). This suggested that mapiquat chloride 100 ppm foliar sprayed at 30 and 45 days after planting helped best in obtaining the higher growth, yield and quality parameters.

The current investigation was designed to assess the response of potato plants to growth regulators and potassium sources treatments and its relation to tubers quality and yield productivity.

MATERIAL AND METHODS

Two field experiments were conducted in Ourabi operation, Cairo-Ismaellia desert road at Kalubia Governorate. The experiment was carried out during the two seasons of 2013/2014 and 2015/2016 (Winter season) to investigate the effect of plant growth regulator (Mepiquat chloride) with three different potassium fertilizers sources on growth, development, total yield in potato plants (*Solanum tuberosum* L. cv. Spunta) .

Experimental design was carried out in a split plot design with four replicates. Where the three different potassium fertilizers sources were located in the main plots and the plant growth regulator was randomly distributed in the sub plots. Each plot size was kept at 6 x 7 m with eight rows of 0.75 meters in width and 7 meters in length.

Physical and chemical properties of the experimental soil were made before sowing, in Central Lab., Faculty of Agric., Ain Shams Univ. are presented in **Table (1-2).**

Table 1. Physical and chemical analysis of the experimental Soil .

Mechanical analysis						Saturation soluble extract						
Particle size distribution				pH	$CaCO_3$%	E.C ds/m	Soluble anions (meq / l)			Soluble cations (ppm)		
Clay	Silt	Sand	Soil texture				HCO_3^-	Cl^-	SO_4^-	K^+	Mg^{++}	Na^+
2%	3%	95%	Sandy	7.31	3	0.36	0.6	1.6	1.4	0.15	0.24	0.21

Table 2. Chemical properties of water using in the experimental farm of Ourabi operation.

Saturation soluble extract									
pH	E.C ds/m	Soluble anions (meq / l)				Soluble cations (meq / l)			
		HCO_3^-	CO_3^-	SO_4^-	Cl^-	Ca^{2+}	Mg^{++}	Na^+	K^+
8.07	0.54	1	n.d	1	3.4	2.1	2.5	0.5	0.3

Rock potassium (KR) (Natural fertilizer contained 70.65% SiO_2 and 10.1% K_2O, produced by **Al-Ahram Company** 300 kg / fed at once during soil preparation for planting. Chemical potassium (KC) 200 kg / fed. Potassium fertilizer (potassium sulphate) was added on two installments at the age of 50 and 70 days from the date of sowing. Foliar potassium (KF) (commercial fertilizer contained 60% K_2O, produced by Union Company) . (1 g/ l) was sprayed three times at 45 , 60 and 75 days after sowing. Mepiquat chloride (MC) 150 ppm spraying was carried out twice for each at four and six weeks after sowing using hand operated compressed air sprayers, while the control plants were sprayed with distilled water. ["Triton B" was used as a wetting agent at the rate of 0.10%].

Each treatment was collected in every season at 50, 85 and 120 days after sowing. Four plants from each treatment were taken randomly at 50 and 85 days to determine plant height (cm), number of branches per plant, fresh and dry weights of shoot (g/plant), number of tubers per plant, weight of tubers (g/ plant), diameter of tubers (mm) and size of tubers (ml) .In addition to leaf area (cm^2/plant) in the 2^{nd} sample, using an Area meter **(II.3000 portable area meter Lin Coin, Nebraska 68504 USA).** Tubers were harvested 120 days after planting. At harvest tubers from each treatment were rinsed free of soil and the following measurements were made: number of tubers/plant, weight of tubers (g/plant),diameter of tubers (mm), size of tubers (ml),total tuber yield (ten/fed).

Statistical analysis of the previous characters was made as described by **Steel and Torrie (1960)** and Duncan's new multiple ranges were used to differentiate between means as described by **Duncan (1955).**

RESULTS AND DISCUSSION

Plant height

The effect of different treatments on potato plant height is presented in **(Table 3).** As for the two seasons potassium sulphate or without mepiquat chloride significant increase in potato plant height as compared to the other treatments after 85 days from sowing. Our results on the effect of mepiquat chloride are in agreement with findings of those obtained from **Hassan et al (1989), Prakash et al (1999) and Jayakumar et al (2001).** Mepiquat chloride reduced plant height significantly compared to the control, which recorded the greatest plant height of potato**.**

In regard to the effect of interaction on plant height, data tabulated in **Table (3)** showed that the highest value was recorded for potassium sulphate and without mepiquat chloride after 85 days from sowing in the two tested seasons. On the other hand, the lowest value was obtained from the interaction between foliar potassium and mepiquat chloride in both seasons.

Number of branches/plant

Results in **Table (3)** illustrated that potassium sulphate (control) and potassium rock significantly increased in number of branches/plant than the application of the same fertilizer with growth retardant which reached the same level of significance in both samples. While, without mepiquat treatment obtained significant increment compared with mepiquat treatment after 85 days from sowing. Obtained results on mepiquat are agreement with those reported by **Hassan et al (1989)** on potato.

As regard for the interaction, data in **Table (3)** indicate that the application of potassium sulphate or potassium rock both of with without mepiquat treatments recorded significant increment compared with the other treatments in both seasons**.**

Fresh and dry weights

Data in **Table (4)** revealed the effect of different treatments on fresh and dry weights of shoot system. Shoot fresh and dry weights of potato plants tended to increase with advancement of age in both seasons. The treatments of potassium sources effect, spraying of potassium foliar or the application of potassium rock increased significantly both fresh and dry weights against the control (KC). This increase in fresh weight reached (25 to 46.87 g/plant) and in dry weights (3.5 to 6.3 g/plant) for the first and second samples respectively. In this connection, spraying of mepiquat chloride had positive effects on fresh and dry weights of potato shoot after 85 days from sowing. . Potassium is an essential plant nutrient that plays a very important role in plant growth and development. Similar results were obtained with **White et al (2005) and Vyakarnahal et al (2010)** on potato.

Results in **Table (4)** showed that the best combination that gave the highest value of fresh and dry weights of shoots appeared to be that involving all potassium sources with mepiquat treatments compared with the other treatments.

Table 3. Effect of chemical potassium (KC), foliar potassium (KF), rock potassium (KR) and growth retardant (mepiquat chloride) applications on potato plant height (cm) and number of branches/plant during the two sampling dates in both seasons.

Sampling dates		Plant height (cm)						Number of branches /plant					
		1st season			2nd season			1st season			2nd season		
	Treatments	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.
1st Sample 50 DAS	KC	30.50^{d}	24.88^{f}	**27.69^{d}**	31.00^{d}	25.00^{g}	**28.00^{d}**	11.75^{a}	9.75^{edf}	**10.75^{a}**	12.00^{a}	10.00^{dce}	**11.00^{a}**
	KF	24.13^{f}	20.88^{g}	**22.50^{f}**	24.63^{g}	21.00^{h}	**22.81^{f}**	10.50^{bdc}	9.00^{f}	**9.75^{b}**	10.75^{bc}	9.250^{e}	**10.00^{b}**
	KR	27.38^{e}	22.00^{g}	**24.69^{e}**	27.88^{e}	22.25^{h}	**25.06^{e}**	11.50^{ba}	9.50^{edf}	**10.5^{ba}**	11.75^{a}	9.750^{de}	**10.75^{a}**
	Mean GR	**27.33^{b}**	**22.58^{c}**	——	**27.83^{b}**	**22.75^{c}**	——	**11.25^{a}**	**9.42^{b}**	——	**11.50^{a}**	**9.67^{b}**	——
2nd Sample 85 DAS	KC	40.50^{a}	30.00^{d}	**35.25^{a}**	41.00^{a}	30.25^{d}	**35.63^{a}**	11.50^{ba}	10.25^{edc}	**10.875^{a}**	11.75^{a}	10.50^{dc}	**11.13^{a}**
	KF	34.13^{c}	25.88^{fe}	**30.00^{c}**	34.50^{c}	26.00^{fg}	**30.25^{c}**	10.25^{edc}	9.25^{ef}	**9.75^{b}**	10.50^{dc}	9.50^{e}	**10.00^{b}**
	KR	37.38^{b}	27.00^{e}	**32.19^{b}**	38.00^{b}	27.25^{fe}	**32.63^{b}**	11.25^{bac}	9.25^{ef}	**10.25^{ba}**	11.50^{ba}	9.50^{e}	**10.50^{ba}**
	Mean GR	**37.33^{a}**	**27.63^{b}**	——	**37.83^{a}**	**27.83^{b}**	——	**11.00^{a}**	**9.58^{b}**	——	**11.25^{a}**	**9.83^{b}**	——

GR=Growth retardant -Duncan within dates, means of GR and means of K fertilizers.
MC= Mepiquat chloride -Means with the same letter are not significantly different at p< 0.05.
Ferti= fertilizer -DAS=day after sowing

Table 4. Effect of chemical potassium (KC), foliar potassium (KF), rock potassium (KR) and growth retardant (mepiquat chloride) applications on fresh weight (g /plant) and dry weight (g /plant) of potato shoot during the two sampling dates in both seasons.

Sampling dates		Fresh weight (g /plant)						Dry weight (g /plant)					
		1st season			2nd season			1st season			2nd season		
	Treatments	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.
1st Sample 50 DAS	KC	25.00^{e}	33.00^{c}	**29.00^{d}**	28.0^{e}	36.00^{c}	**32.00^{d}**	3.53^{f}	4.77^{cd}	**4.15^{e}**	3.95^{e}	5.21^{c}	**4.58^{e}**
	KF	29.00^{d}	34.50^{c}	**31.75^{c}**	32.0^{d}	37.50^{c}	**34.75^{c}**	4.18^{e}	4.82^{cd}	**4.50^{d}**	4.63^{d}	5.27^{c}	**4.95^{d}**
	KR	30.00^{d}	34.88^{c}	**32.438^{c}**	33.0^{d}	37.88^{c}	**35.44^{c}**	4.66^{d}	5.08^{cbd}	**4.87^{c}**	5.17^{c}	5.56^{cb}	**5.36^{c}**
	Mean GR	**28.00^{d}**	**34.13^{c}**	——	**31.00^{d}**	**37.13^{c}**	——	**4.12^{d}**	**4.89^{c}**	——	**4.58^{c}**	**5.35^{b}**	——
2nd Sample 85 DAS	KC	34.00^{c}	42.00^{a}	**38.00^{b}**	37.00^{c}	45.25^{a}	**41.13^{b}**	4.80^{cd}	6.08^{a}	**5.44^{b}**	5.22^{c}	6.55^{a}	**5.88^{b}**
	KF	38.00^{b}	43.50^{a}	**40.75^{a}**	41.00^{b}	46.50^{a}	**43.75^{a}**	5.14^{cb}	6.06^{a}	**5.60^{b}**	5.50^{cb}	6.53^{a}	**6.02^{b}**
	KR	39.00^{b}	43.88^{a}	**41.44^{a}**	42.00^{b}	46.875^{a}	**44.44^{a}**	5.48^{b}	6.39^{a}	**5.93^{a}**	5.91^{b}	6.83^{a}	**6.36^{a}**
	Mean GR	**37.33^{b}**	**43.13^{a}**	——	**37.83^{b}**	**46.21^{a}**	——	**5.14^{b}**	**6.18^{a}**	——	**5.54^{b}**	**6.64^{a}**	——

GR=Growth retardant -Duncan within dates, means of GR and means of K fertilizers.
MC= Mepiquat chloride -Means with the same letter are not significantly different at p< 0.05.
Ferti= fertilizer -DAS=day after sowing

Leaf area

Data presented in **Table (5)** revealed the effect of different treatments on leaf area of potato plant after 85 days from sowing in both seasons. The leaf area in the 2nd season run parallel to the detected in the 1st season with the same level of significance in the 2nd sampling data. Application of potassium chemical had significant effect on leaf area. On the other hand, the best treatment was detected with without mepiquat chloride treatment. Decreased in leaf area by growth under spraying of mepiquat was observed by **Prakash et al (2001)** on potato.

Concerning the interaction between potassium sources and growth regulator treatment data in **Table (5)** showed that the best combination was detected with spraying of mepiquat chloride with application of potassium sulphate fertilization recorded significant increment in leaf area are against the application of mepiquat chloride with the other potassium fertilizers.

Table 5. Effect of chemical potassium (KC), foliar potassium (KF), rock potassium (KR) and growth retardant (Mepiquat chloride) applications on leaf area (cm^2/plant) of potato plants in the 2nd sample in both seasons.

Sampling dates		1st season			2nd season		
	Treatments	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.
2nd Sample 85 DAS	KC	39.00^{a}	29.00^{c}	**34.00^{a}**	39.80^{a}	29.80^{c}	**34.80^{a}**
	KF	37.50^{ba}	25.50^{d}	**31.50^{b}**	38.43^{ba}	26.30^{d}	**32.36^{b}**
	KR	36.00^{b}	23.30^{d}	**29.65^{c}**	36.80^{b}	24.10^{d}	**30.45^{c}**
	Mean GR	**37.50^{a}**	**25.93^{b}**	———	**38.34^{a}**	**26.73^{b}**	———

GR=Growth retardants -Duncan within sampling date, means of GR and means of K fertilizers.
MC= Mepiquat chloride -Means with the same letter are not significantly different at p> 0.05.
Ferti= fertilizer -DAS=day after sowing

Tubers number/plant

In respect to the effect of potassium sources, data in **Table (6)** show that there were no significant differences in potassium sources on number of potato tubers/plant during the three sampling dates of the two seasons. On the other hand, spraying of mepiquat chloride at 150 ppm obtained significant increase on number of potato tubers/plant compared with control treatment. Similar results were obtained with **Hassan et al (1989); Birbal and Kushwah (2003).**

It clear from results in **Table (6)** that the best treatments combination were potassium sources with spraying of mepiquat chloride treatment in all growth periods in both seasons.

Potato tuber weight

Data of potato tubers weight /plant during the three sampling dates in both seasons are presented in **Table (6).** Weight of tubers (g/plant) gently increased significantly (especially with GRs) with advancement of plant age (50, 85 and 120 days). The highest value of mean of potato tuber weight was obtained from application of potassium rock after 120 days from sowing in both seasons following by potassium foliar treatment compared with the other treatments. However, spraying of mepiquat chloride gave significant increment on mean of potato tuber weight after 120 days from sowing in two seasons. Similar results were obtained with **Tsegaw *et al*.(2005)** who showed that mepiquat chloride (MC) used in crop field management with many purposes including potato quality**.**

Data listed in **Table (6)** show that the highest value of mean of potato tuber weight appeared to be that involving potassium rock treatment with spraying of mepiquat chloride following by potassium foliar with mepiquat chloride after 120 days from sowing in both seasons**.**

Tuber diameter

Data presented in **Table (7)** illustrated the effect of three potassium sources on tuber diameter during three sampling dates in both seasons. It is clear that significant increase in tubers diameter was achieved by the application of potassium rock and potassium foliar fertilization after 120 days. However, mepiquat chloride had superior tuber diameter after 120 days from sowing in both seasons.

Regarding the interaction effect, data in **Table (7)** indicated that the application of potassium rock and potassium foliar with mepiquat chloride gave the highest value of tubers diameter after 120 days from sowing in both seasons.

Tuber size

Table (7) revealed the effect of different treatments on potato tuber size during the three sampling dates in both seasons. It is clear that the size of tubers increased with advancement of plant age (50, 85 and 120 days).

Table 6. Effect of chemical potassium (KC), foliar potassium (KF), rock potassium (KR) and growth retardant (mepiquat chloride) applications on number of potato tubers/plant and mean of potato tuber weight (g)/plant during the two sampling dates in both seasons.

Sampling dates		Number of potato tubers/plant						Mean of potato tuber weight (g)/plant					
		1st season			2nd season			1st season			2nd season		
	Treatments	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.
1st Sample 50 DAS	KC	0^{c}	5^{a}	**2.5^{b}**	0^{c}	5^{a}	**2.5^{b}**	0.000^{i}	110.0^{gh}	**55.00^{g}**	0.000^{i}	115.5^{gh}	**57.75^{e}**
	KF	4^{b}	5^{a}	**4.5^{a}**	4^{b}	5^{a}	**4.5^{a}**	70.20^{h}	112.6^{gh}	**91.40^{fg}**	75.20^{h}	117.8^{gh}	**96.50^{de}**
	KR	4^{b}	5^{a}	**4.5^{a}**	4^{b}	5^{a}	**4.5^{a}**	102.0^{gh}	120.0^{fgh}	**111.0^{fe}**	107.3^{gh}	125.0^{fgh}	**116.1^{de}**
	Mean GR	**2.67^{c}**	**5^{a}**	———	**2.67^{c}**	**5^{a}**	———	**57.40^{e}**	**114.2^{d}**	———	**60.80^{e}**	**119.4^{d}**	———
2nd Sample 85 DAS	KC	4^{b}	5^{a}	**4.5^{a}**	4^{b}	5^{a}	**4.5^{a}**	97.90^{h}	202.5^{ecd}	**150.2^{de}**	102.9^{h}	208.0^{ecd}	**155.5^{dc}**
	KF	4^{b}	5^{a}	**4.5^{a}**	4^{b}	5^{a}	**4.5^{a}**	180.9^{efgd}	220.3^{bcd}	**200.6^{dc}**	185.9^{efgd}	225.3^{bcd}	**205.6^{bc}**
	KR	4^{b}	5^{a}	**4.5^{a}**	4^{b}	5^{a}	**4.5^{a}**	197.8^{efcd}	269.1^{bc}	**233.4^{bc}**	202.8^{efcd}	274.1^{bc}	**238.4^{ba}**
	Mean GR	**4^{b}**	**5^{a}**	———	**4^{b}**	**5^{a}**	———	**158.9^{c}**	**230.6^{b}**	———	**163.8^{c}**	**235.8^{b}**	———
3rd Sample 120 DAS	KC	4^{b}	5^{a}	**4.5^{a}**	4^{b}	5^{a}	**4.5^{a}**	138.1^{efgh}	270.0^{bc}	**204.1^{c}**	142.0^{efgh}	275.0^{bc}	**208.5^{bc}**
	KF	4^{b}	5^{a}	**4.5^{a}**	4^{b}	5^{a}	**4.5^{a}**	243.8^{bcd}	293.8^{ba}	**268.8^{ba}**	248.8^{bcd}	298.8^{ba}	**273.8^{ba}**
	KR	4^{b}	5^{a}	**4.5^{a}**	4^{b}	5^{a}	**4.5^{a}**	263.8^{bc}	358.8^{a}	**311.3^{a}**	268.8^{bc}	363.8^{a}	**316.3^{a}**
	Mean GR	**4^{b}**	**5^{a}**	———	**4^{b}**	**5^{a}**	———	**215.2^{b}**	**307.5^{a}**	———	**219.8^{b}**	**312.5^{a}**	———

GR=Growth retardant - Duncan within dates, means of GR and means of K fertilizers.
MC= Mepiquat chloride - Means with the same letter are not significantly different at p< 0.05.
Ferti= fertilizer - DAS=day after sowing

Table 7. Effect of chemical potassium (KC), foliar potassium (KF), rock potassium (KR) and growth retardant (mepiquat chloride) applications on mean of potato tuber diameter (mm) and mean of potato tuber size (ml) during the two sampling dates in both seasons.

Sampling dates		Mean of potato tuber diameter (mm)						Mean of potato tuber size (ml)					
		1st season			2nd season			1st season			2nd season		
	Treatments	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.
1st Sample 50 DAS	KC	0.00^{h}	28.4^{gf}	**14.18^{e}**	0.00^{g}	30.00^{fe}	**15.00^{e}**	00.00^{e}	20.00^{e}	**10.00^{d}**	0.00^{e}	24.00^{e}	**12.00^{d}**
	KF	23.3^{gf}	30.0^{gf}	**26.65^{d}**	26.03^{fe}	32.03^{fe}	**29.03^{d}**	10.00^{e}	29.00^{ed}	**19.50^{d}**	12.00^{e}	33.00^{ed}	**22.50^{d}**
	KR	25.3^{gf}	34.8^{ef}	**30.03^{dc}**	27.25^{fe}	37.00^{de}	**32.13^{dc}**	15.00^{e}	39.00^{ed}	**27.00^{d}**	17.00^{e}	43.00^{ed}	**30.00^{d}**
	Mean GR	**16.18^{e}**	**31.05^{d}**	———	**17.76^{f}**	**33.01^{e}**	———	**8.330^{d}**	**29.33^{d}**	———	**9.67^{d}**	**33.30^{d}**	———
2nd Sample 85 DAS	KC	21.8^{g}	49.5^{d}	**35.65^{c}**	23.81^{f}	51.50^{c}	**37.65^{c}**	81.50^{ed}	202.8^{bac}	**142.1^{c}**	84.5^{ed}	206.8^{bac}	**145.6^{c}**
	KF	46.5^{ed}	51.7^{dc}	**49.03^{b}**	48.50^{c}	53.56^{bc}	**51.03^{b}**	185.6^{bc}	215.6^{bac}	**200.6^{bac}**	188.6^{bc}	219.6^{bac}	**204.1^{bac}**
	KR	47.1^{ed}	52.3^{bdc}	**49.69^{b}**	51.56^{c}	54.31^{bc}	**52.94^{b}**	193.3^{bc}	259.5^{ba}	**226.4^{ba}**	196.3^{bc}	263.5^{ba}	**229.9^{ba}**
	Mean GR	**38.46^{c}**	**51.12^{b}**	———	**41.29^{d}**	**53.13^{c}**	———	**153.5^{c}**	**225.9^{ba}**	———	**156.5^{c}**	**229.9^{ba}**	———
3rd Sample 120 DAS	KC	44.2^{ed}	66.0^{a}	**55.09^{b}**	48.25^{dc}	69.00^{a}	**58.63^{b}**	129.8^{dc}	245.0^{ba}	**187.4^{bc}**	134.8^{dc}	249.0^{ba}	**191.9^{bc}**
	KF	64.1^{ba}	68.8^{a}	**66.44^{a}**	68.13^{a}	71.75^{a}	**69.94^{a}**	224.0^{bac}	259.0^{ba}	**241.5^{ba}**	229.0^{bac}	263.0^{ba}	**246.0^{ba}**
	KR	62.8^{bac}	69.8^{a}	**66.25^{a}**	64.75^{ba}	72.75^{a}	**68.75^{a}**	236.0^{bac}	**310.0^{a}**	**273.0^{a}**	239.0^{bac}	314.0^{a}	**276.5^{a}**
	Mean GR	**57.02^{b}**	**68.17^{a}**	———	**60.37^{b}**	**71.17^{a}**	———	**196.6^{bc}**	**271.3^{a}**	———	**200.9^{bc}**	**275.3^{a}**	———

GR=Growth retardant -Duncan within dates, means of GR and means of K fertilizers.
MC= Mepiquat chloride -Means with the same letter are not significantly different at p< 0.05.
Ferti= fertilizer -DAS=day after sowing

Rock potassium fertilization increased tubers size following by potassium foliar against the control (KC) and this increment between KF and KR reached the same level of significance in each sample after 85 and 120 days from sowing. Moreover, spraying of mepiquat chloride treatment obtained significant increment compared with without mepiquat chloride after 120 days from sowing. Obtained results on mepiquat chloride are agreeable with those reported by **Hassan et al (1989) and Tsegaw et al (2005)** on potato.

Results in **Table (7)** showed that the best combination treatment among rock potassium fertilization or potassium foliar with spraying of mepiquat chloride increased tubers size after 85 and 120 days from sowing in both seasons.

Total tubers yield

In respect to the application of potassium fertilizers effect, it is clear from **Table (8)** that the application of rock potassium fertilization produced the highest value on total tubers yield than the other potassium fertilizers. While, the same effect was obtained by the application of potassium chemical or potassium foliar after 120 days from sowing in both seasons. In addition to, spraying of mepiquat chloride recorded high production of potato yield compared with non-treatment plants after 120 days from sowing in two tested seasons. These results are in agreement with those obtained by **Gasti et al (1997), Eyob & Krishnappa (1999), Tavares and Lucchesi (1999), Bama et al (2001), Jayakumar et al (2001), Prakash et al (2001), Birbal and Kushwah (2003)**, **Mahadevmurthy & Nagarathna (2008) and Vyakarnahal et al (2010)** who applied mepiquat chloride MC at 150 ppm led to the highest yields in potatoes (33.29 t/ha), this represented yield increases 29.03%, over the control**.**

As effect of the interaction, results in **Table (8)** indicated that the application of rock potassium combined with spraying of mepiquat chloride reflected the highest value of total tubers yield after 120 days from sowing in both seasons. However, the lowest value was obtained with the application of potassium chemical with without spraying of mepiquat chloride after 120 days from sowing in both seasons.

Table 8. Effect of three different sources of potassium (KC, KF& KR) and growth retardant (MC) on total potato tubers yield (ton/fed) at harvesting stage in both seasons.

Sampling date		1st season			2nd season		
	Treatments	0	MC 150 ppm	Mean K ferti.	0	MC 150 ppm	Mean K ferti.
3rd Sample 120 DAS	KC	2.583^{b}	5.049^{a}	**3.8160^{b}**	2.679^{c}	5.187^{ba}	**3.9330^{b}**
	KF	4.558^{ba}	5.493^{a}	**5.0255^{ba}**	4.695^{b}	5.623^{ba}	**5.1590b^{a}**
	KR	4.932^{a}	6.708^{a}	**5.8200^{a}**	5.065^{ba}	6.839^{a}	**5.9520^{a}**
	Mean GR	**4.0243^{b}**	**5.750^{a}**	———	**4.1463^{b}**	**5.883a**	———

GR=Growth retardants - Duncan within date, means of GR and means of K fertilizers.
MC= Mepiquat chloride - Means with the same letter are not significantly different at p< 0.05.
Ferti= fertilizer - DAS=day after sowing

CONCLUSION

Rock potassium with mepiquat chloride obtained the highest productivity of fresh and dry weights, total tuber yield and tubers yield components (weight of tubers, size of tubers, diameter of tubers and number of tubers) following by foliar potassium with mepiquat chloride compared with control treatment.

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البوتاسيوم على نمو ومحصول نبات البطاطس تأثير المبيكوات كلوريد ومصادر [3]

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الموجـــــز

في هذه الدراسة تم إجراء تجربتين ميدانيتين في مزرعة بجمعيه عرابي، طريق القاهرة الاسماعيلية الصحراوي بمحافظة القليوبية .أجريت التجربة خلال موسمي 2014/2013 و2016/2015، لدراسة تأثير منظم نمو النبات مبيكوات كلوريد مع ثلاثة مصادر مختلفة لأسمدة البوتاسيوم [البوتاسيوم الكيميائي (KC) البوتاسيوم الورقي (KF) وصخور البوتاسيوم(KR)] على النمو والتطور والإنتاج الكلي في نباتات البطاطس (*Solanum tuberosum* L. cv. Spunta).

البوتاسيوم الكيميائي (الكنترول) مع /بدون مبيكوات كلوريد يحقق ارتفاعا أفضل في النبات، عدد السوق ومساحه الورقة. في حين ان البوتاسيوم الصخري مع مبيكوات كلوريد حقق أعلى إنتاجية للوزن الرطب والجاف، وإجمالي محصول الدرنات وصفات المحصول (وزن الدرنات، وحجم الدرنات، قطر الدرنات وعدد الدرنات) يليها البوتاسيوم الورقي مع مبيكوات كلوريد مقارنة مع معامله الكنترول.

الكلمات الدالة: نبات البطاطس، البوتاسيوم الصخري، البوتاسيوم الكيميائي، البوتاسيوم الرش الورقي، مبيكوات كلوريد.

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