Effect of Nitrogen and Potassium Fertilization on Productivity and Quality of Four Potato (*Solanum tuberosum* L.) Cultivars

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Keywords

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Abstract

This study was carried out at the El-Kawther Experimental Farm, Faculty of Agriculture, Sohag University, Sohag, Egypt during two successive seasons of 2014/2015 and 2015/2016 to investigate the effect of nitrogen and potassium fertilization on the productivity and quality of four cultivars of potato (Sponta, Brn, Oceana and chara) grown under Sohag Province conditions. Three nitrogen/potassium rates (90N: 48K, 120N:90K and 150N:120K units feddan^{-1}. The obtained results clearly showed that there were significant differences among the four cultivars and the three levels of fertilization among the most of studied characters under this study. The cultivar Chara is the best one on the total yield (9.88 and 10.03 ton/ fed), yield component and most of quality traits. In the case of sowing in the sandy soils under Sohag conditions it was been that the third level (N150:K120) gave the best results. Sponta cultivar was the best on some of the quality traits such as dry matter and starch. Finely the cultivar Chara with the third level of fertilization is the best in the total yield and its components and most of quality traits.

INTRODUCTION

Potatoes (*Solanum tuberosum* L.) is considered one of the most important strategic crops for the populations all over the world and comes at the fourth stage after wheat, rice, and maize**.** It plays a vital role in the Egyptian diet it has production nearly 4265178 tons from about 381379 fed with average yield 11.184 ton per fed **(Agriculture Directorates in Governorate, 2014).** Potato is considered as the most important tuber crop. Moreover it is an important vegetable and a good source of antioxidants**.** Potato is a major source of inexpensive energy; it contains high levels of carbohydrates and amount of vitamins B, C and minerals **(Muthoni and Nyamongo 2009).**The tubers are a good source of starch, proteins, vitamins, sugars, minerals and other useful substances when eaten as an essential dish and with major quantities for long time **(Blagoeva *et al*., 2004).** Potato composition various greatly between different cultivars but generally comprises 63-87 % water, 13-37 % dry matter, 13-30 % carbohydrate, 0.7 -4.6 % protein 0.02-0.96%lipids , 0.2-

3.5 % fiber, 0.4-2 ash **(Torres and Parreno , 2009).** Also no one can deny that nitrogen fertilizer plays a direct effect on growth behavior and yield quality, Nitrogen is the element which stimulates above-ground growth and produces the rich, green color characteristic of healthy plant and increases the protein percentage. Nitrogen fertilization increases tuber and dry matter yield and the nitrogen content in potato plants **(Neshev *et al*., 2014)**. Application of nitrogen and potassium depressed dry matter content at the deficiency of phosphorus. Potassium and nitrogen fertilization is required for maximum potato production. Both elements and source of potassium (KCl, K_2SO_4) affect yield and quality of potatoes **(Neshev and Manolov , 2015).** One important factor during cultivation influencing tuber yield and quality is an adequate and balanced fertilizer supply. Potato crops require large amounts of nutrients and therefore a large amount of fertilizers are applied for their production **(Luz *et al.*, 2013).** Among the major nutrients, potassium (K) is required in high amounts due to its important role on plant physiology. K contributes to many aspects, for example it stimulates enzyme activities, promotes protein synthesis, improves photosynthesis, supports on osmoregulation, regulates opening and closure of stomata and participate on nutrients translocation **(Marschner, 1995; Mengel, 2007).** With regard to these functions, an adequate supply of K in the potato plant dictates improvements of tubers quality, such as increasing yield of processed-grade tubers, decreasing black spot susceptibility and hollow heart, improving processing properties and chips color, as well as increasing plant resistance to disease, pathogens and environmental stresses. The aim of the study was to determine the effect of three levels of Nitrogen and Potassium fertilization on four potato cultivars and their interactions on growth, yield and its components under Sohag conditions.

MATERIALS AND METHODS:

This study was carried out at the Experimental farm of El- kawthar, Faculty of Agriculture, Sohag university, Sohag, Egypt during seasons of 2014/2015 and 2015/2016. Four potato cultivars i.e., (Sponta , Brn ,Oceania and Chara) were obtained from Agriculture Research Center, Giza Egypt to study the effect of three levels of nitrogen (NH_4NO_3 ; ammonium nitrate 33.5%) and potassium (K_2SO_4 potassium sulphate 50%) fertilization on these potato cultivars under Sohag conditions. Nitrogen chemical fertilizer was applied in two equal doses after 10 and 30 days from planting. Whereas, phosphorus chemical fertilizer was applied as one does (the recommended dose 100 kg P/fed.) just before planting in the form of calcium superphosphate (15.5% P_2O_5)

Potassium fertilizer was applied in two equal doses after 45 and 65 days from planting. The potato tubers were planted at 5th of October at both studied seasons. Other agricultural practices of irrigation, pest control…, etc, were applied as recommended for potato productions. In this investigation were used three levels of fertilization as follow:- (1) Level 1 (90N: 48K) units /fed. (2) Level 2 (120 N: 90 K) units /fed. (3)Level 3 (150 N: 120K) units /fed. Ten soil sample were randomly taken form soil before planting , air dried, crushed, sieved and used to determine, the following physical and chemical analysis of the experimental soil in two seasons are presented in Table (1).

Table 1. Some physiochemical characteristics of El- kawthar experimental farm .

Character	2014-2015	2015-2016	Character	2014-2015	2015-2016
Depth (cm)	0-30	0-30	**Sand %**	69.66	70.09
EC (1-5) dsm-1	4.09	4.2	**Texture grade**	Sandy Loam	Sandy Loam
pH	8.1	8.0	**Total N %**	0.172	0.169
CaCO3%	11.8	11.4	**P (ppm)**	10.5	10.2
Clay %	7.7	7.31	**K (ppm)**	303	320
Silt %	22.64	22.60	**Sand %**	69.66	70.09
Organic matter %	1.6	1.91			

Experimental design :

Randomized complete plot design in split-plot with three replicates was carried out, while cultivars were allocated randomly in the main–plots, While the fertilizers treatments were allocated in the sub-plot. The experimental plot area was 10.5m^2 (3.5 length X 3 width), consisting of five ridges. Some cultivars characteristics are presented in Table 2.

Table 2. Some cultivars characteristics information under the study.

Cultivars / Characteristics	Sponta	Brn	Oceania	Chara
Shape of tuber	Long	Oval – long	Oval	Short – oval
Colour of skin	Yellow	Cream	Yellow	Red party- colored
Colour of flesh	Yellow-cream	Medium yellow	Yellow-cream	Cream
Depth of eyes	Shallow	Shallow	Deep	Shallow
Smoothness of skin	Medium	Medium	Medium	Medium
Maturity	Early main crop	Early main crop	Main crop	Main crop
Height of plants	Tall- very tall	Medium – tall	Medium - tall	Tall
Colour of flower	White	White	White	White
Resistance to late blight	Medium	Medium	Medium	High
Resistance to p. virus (x&y)	High	Low	Medium	High

Studied characteristics:

1-Plant height (cm) **2-Number of main stems/plant**

3-Number of tubers plant^{-1} **4-Average tuber weight (g)**

5- Total yield (ton\fed)

6-Dry matter percentage (%): dry matter was determined by drying small pieces of tubers at 80°C for 72 hr in oven **and calculated according the next formula:**

%DM = (dry weight ÷ Total fresh weight) x 100

7-Starch (percentage):

The percent of starch of potato tubers was determined according to A.O.A.C (2000).

Statistical analysis:-

The data were statistically analyzed acceding to Gomez and Gomez (1984), each season separately by using pro Colum procedure by using (SAS 9.1, SAS institute 2003) the least significant difference (LSD) at 5% and the correlation coefficients between the traits were calculated by SAS procedure.

RESULTS AND DISCUSSION

1-Plant Height (cm):

Data dealing with the effect of both nitrogen and potassium fertilizers and their interactions on plant height of four potato cultivars in (2014/2015) and (2015/2016) seasons are presented in Table (3), Data clearly show that there were significant differences among the four potato cultivars in both studied seasons. The tallest potato cultivar plants were recorded by Sponta (55.86 and 65.72 cm) in both studied seasons, respectively. While, the shortest plant height was recorded for cultivar Brn in both seasons. These results are in agreement with those reported by **Ali Jasim *et al*., (2013**) who showed that the cultivars had a significant effect in plant height. On the other hand, there were significant differences among the three levels of fertilizers in both studied seasons. The highest values was obtained by using the second level of fertilizer (N120:K90) in both seasons and there was no significant difference between the second level and third level in first season. While in the second season there were significant differences among the three fertilizer levels. These findings are in agreement with those reported by **Yassen *et al*., (2011), Amir Ali Najm *et al*., (2013) and Sanjana, *et al*., (2014)** they found that nitrogen application resulted in an increase in plant height . While, **Abd El-Latif *et al*., (2011)**, **Ali Jasim *et al*., (2013)** and **Bishnu and Krishna (2006)** found that Potassium enhances potato plant height . The effect of nitrogen due to its influence and indirectly to some of the biological processes that occur Which (Tryptophan) in Al mrstimih areas, since nitrogen is an essential element for the construction of his tidine It is important in stimulating plant growth (**Wareaing (1983),** and nitrogen enters in the composition of IAA is the basic material for the synthesis of the Which lead to increased growth **(Mohammed *et al*., (1984)**. The role of Potassium in influencing many physiological processes such as photosynthesis and respiration The material composition of green and encourage cell division and growth of tissue construction **(Yassen Taha (2001)**. While, the impact of the two elements may be due to the integration of these elements in the impact and reflection so positively on growth, as agreed with the results reached by **El-Tantawy *et al*., (1993)**. The

interaction between the four potato cultivars and the three fertilizer levels are presented in Table (3). The results indicated that there were significant differences among most interactions in this trait in both studied seasons. The tallest potato plant were obtained when Sponta potato plants were fertilized with the second level (N120:K90) of chemical fertilizer in both seasons. Also the interaction between fertilizer and cultivars had significant effects on plant height **(Ali *et al.*, 2013).**

Table (3) Effect of three levels of potassium and nitrogen on plant height (cm) of four potato cultivars grown under Sohag conditions in two successive seasons (2014\2015) and (2015\2016).

	Fertilizer levels (F)							
	First Season **(2014/2015)**				Second Season **(2014/2015)**			
Cultivars (C)	**Level 1 (N90:K48)**	**Level 2 (N120:K90)**	**Level 3 (N150:K120)**	**Mean**	**Level 1 (N90:K48)**	**Level 2 (N120:K90)**	**Level 3 (N150:K120)**	**Mean**
Sponta	50.10	61.91	55.56	55.86^{A}	53.70	62.53	53.93	65.72 ^{A}
Brn	47.03	48.47	47.0	47.83^{B}	44.03	51.94	45.00	46.99 ^{C}
Oceania	52.0	51.33	54.6	52.64^{A}	51.06	49.93	54.20	51.73 ^{B}
Chara	52.86	55.4	56.53	54.64^{A}	50.33	54.86	55.80	53.66 ^{B}
Mean	50.5^{B}	54.43^{A}	53.93^{A}		49.78^{C}	54.81^{A}	52.23^{B}	
LSD $_{5\%}$	C: 4.42 F: 1.82 C x F: 3.65				C: 2.83 F: 2.42 C x F: 4.85			

2-Number of Branches per Plant:

Data concerning the effect of nitrogen and potassium chemical fertilization on number of branches per plant during (2014/2015) and (2015/2016) seasons are shown in Table (5) . Results clearly reveal that there were significant differences among the four potato cultivars in this study. Both Brn and Oceania cultivars were significantly higher than other potato cultivars in this trait in both seasons. These findings are in agreement with those reported by **Ali Jasim et *al.*, (2013**) who showed that the varieties had a significant effect on stem numbers. The effect of three levels of fertilizer on this trait also presented in Table (5) . The results indicated that the third level of fertilizer (N150:K120) was the best level and significantly higher than other chemical levels in this trait in both studied seasons. These results are in accordance with those found by **Bishnu and Karki (2006)**, **Kamal**

Esho *et al*., (2009) and **Sanjana *et al*., (2014)** they found that plant growth characters, branch numbers of the potato crops were increased with increasing nitrogen fertilizer. The role of nitrogen belong to its effect on increasing the cell diffusion and protein content and make a big leave area and gave a lot of leaves as food source that needed in plant growth and the center of creating geprelien that active the ternal shoot growth and increase the number of branches .The role of potassium because of its effect in many of vital process enter the plant which include the enzyme work that active plant growth. Potassium increase plant protection against insects which gave a strong and healthy plant body. **El- Tantawy *et al*., (1993), El-Shafia (1979) and Abd-alla and saaed (2003)**. Regarding to the combinations between chemical fertilizers and potato cultivars, data in the above mentioned table obviously reveal that the best combination was fertilize the Brn cultivar with the third level of chemical fertilizer in both studied seasons. The impact of the two elements may be due to the integration of these elements in the impact and reflection so positively on growth.

Table (4) Effect of three levels of potassium and nitrogen on number of branches /plant of four potato cultivars grown under Sohag conditions in two successive seasons (2014\2015) and (2015\2016).

	Fertilizer levels (F)							
	First Season **(2014/2015)**				Second Season **(2014/2015)**			
Cultivars (C)	**Level 1 (N90:K48)**	**Level 2 (N120:K90)**	**Level 3 (N150:K120)**	**Mean**	**Level 1 (N90:K48)**	**Level 2 (N120:K90)**	**Level 3 (N150:K120)**	**Mean**
Sponta	2.53	2.43	3.10	2.68^{B}	2.40	2.53	3.13	2.68^{B}
Brn	4.46	4.13	5.96	4.85^{A}	4.73	4.46	5.70	4.96^{A}
Oceania	3.73	4.33	4.80	4.28^{A}	3.70	4.50	4.26	4.15^{B}
Chara	2.20	2.30	2.53	2.34^{B}	2.20	2.26	2.66	3.94^{A}
Mean	3.23^{B}	3.30^{B}	4.10^{A}		3.25^{B}	3.44^{B}	3.94^{A}	
LSD $_{5\%}$	C: 0.73 F: 0.49 C x F: 0.98				C: 0.66 F: 0.42 C x F: 0.85			

3-Number of Tubers per Plant:

Data concerning the effect of nitrogen and potassium chemical fertilization on Number of tubers / plant during (2014/2015) and (2015/2016) seasons are shown in Table (5). Results clearly reveal that there were significant differences among the four potato cultivars in this study. Brn cultivar was significantly higher and gave the highest value than other potato cultivars in this trait in both

seasons, While, Sponta cultivar was significantly the lowest cultivars in this trait in both seasons. **Jami Moayani *et al*., (2009)** concluded that there were significant differences among potato cultivars in their mean tuber number/plant. But **Mehdi *et al*., (2011)** found that the effect of cultivar on mean tuber number/plant was not significant. The effect of three levels of fertilizer in this trait also presented in Table (5) .The results indicated the second level of fertilizer was the best level and there was a not significant difference with the third level. While, the first level gave the lowest value in this characters in both studied seasons. These results are in line with those found by **Alaa Ati *et al*., (2012) and Bishnu and Krishna (2006**) who indicated that the entire yield characteristic included tuber number per plant were affected by potassium fertilizer treatment. But **Bansel and Trehan (2011)** found that potassium increase the size of tuber not total number of tubers .Regarding to the combinations between chemical fertilizers and potato cultivars, data in the above mentioned Table obviously reveal that there were significant differences among all combinations in both seasons and the best combination was fertilize the Brn cultivar with the second and third levels of chemical fertilizer in both studied seasons. This is in agreement with foregoing researches **(Saeedi (2007); Koochaki (2006).**

Table (5) Effect of three levels of potassium and nitrogen on number of tubers per plant of four potato cultivars grown under Sohag conditions in two successive seasons (2014\2015) and (2015\2016).

	Fertilizer levels (F)							
	First Season **(2014/2015)**				Second Season **(2014/2015)**			
Cultivars (C)	**Level 1 (N90:K48)**	**Level 2 (N120:K90)**	**Level 3 (N150:K120)**	**Mean**	**Level 1 (N90:K48)**	**Level 2 (N120:K90)**	**Level 3 (N150:K120)**	**Mean**
Sponta	4.53	4.80	4.96	4.76^{C}	4.33	5.06	4.90	4.76^{D}
Brn	9.45	11.53	11.16	10.71^{A}	9.41	12.60	11.80	11.27^{A}
Oceania	6.13	7.60	8.46	7.40^{B}	6.06	7.66	7.86	7.20^{B}
Chara	4.93	7.00	6.10	6.01^{BC}	4.80	6.46	6.63	5.96^{C}
Mean	6.26^{B}	7.73^{A}	7.67^{A}		6.15^{B}	7.95^{A}	7.80^{A}	
LSD 5%	C: 1.41 F: 0.76 C x F: 1.52				C : 0.82 F : 0.68 C x F : 1.36			

5-Total yield (ton\fed)

Data concerning the effect of nitrogen and potassium chemical fertilization on total yield (ton/fed) during (2014/2015) and (2015/2016) seasons are shown in Table (6) . Results clearly reveal that there were significant differences among the four potato cultivars in this character. Chara cultivar was significantly surpassed the other potato cultivars and recorded the highest values in this trait (9.887 and 10.038 ton /fed) in both seasons. These results in line with those obtained with **Ali *et al.*, (2013)** who found that cultivars had a significant effect on the total yield and contrary with those found by **Mohammad *et al.*, (2012)** found that cultivars did not affect total tuber yield. The effect of three levels of fertilizer in this trait also presented in Table (6) . The results indicated the third level (N150 and K120) of fertilizer was the best level and significantly higher than other chemical levels in this trait and gave (7.566 and 7.605) in both studied seasons. These results are in accordance with those found by **Alaa Ati *et al.*, (2012) Ali *et al.*, (2013), Nikardi Gunadi (2009), Bansal and Trehan (2011) and Asmaa and Magda (2010)** indicated that all the yield characteristic such as, Tuber yield and total yield was affected significantly by the K fertilizer sources and application methods .Also, found that the total tuber yield was gradually and significantly increased with increasing the level of potassium application. On the other hand, **Kamal *et al*., (2009), Yassen *et al*., (2011) and Mohammad *et al*., (2012)** found that nitrogen fertilizer had highly significant effect on total tuber yield. Finely, **Westermann *et al*., (1994)** investigated that both N and K level and application increased yield. Regarding to the combinations between potato cultivars and chemical fertilizers, data in the above mentioned table obviously reveal that the best combination was fertilize Chara cultivar with the third level of chemical fertilizer in this trait in both studied seasons. These results are in accordance with those found by **Ali *et al*., (2013) and Semiha Guler (2009)** found that the total yield was significantly affected by both fertilizer and cultivar.

Table (6) Effect of three levels of potassium and nitrogen on total yield (ton/fed) of four potato cultivars grown under Sohag conditions in two successive seasons (2014\2015) and (2015\2016)..

	Fertilizer levels (F)							
	First Season (2014/2015)				Second Season (2014/2015)			
Cultivars (C)	Level 1 (N90:K48)	Level 2 (N120:K90)	Level 3 (N150:K120)	Mean	Level 1 (N90:K48)	Level 2 (N120:K90)	Level 3 (N150:K120)	Mean
Sponta	2.799	4.136	4.662	3.866^{D}	2.750	4.161	4.779	3.897^{D}
Brn	4.898	6.419	6.321	5.879^{C}	5.064	6.548	6.419	6.011^{C}
Oceania	5.589	6.661	7.723	6.658^{B}	5.713	6.534	7.423	6.557^{B}
Chara	8.337	9.763	11.560	9.887^{A}	8.443	9.874	11.797	10.038^{A}
Mean	5.406^{C}	6.745^{B}	7.566^{A}		5.493^{C}	6.779^{B}	7.605^{A}	
LSD 5%	C: 301.31	F: 235.6	C x F: 471.21		C: 451.15	F: 273.16	C x F: 546.34	

6-Dry matter percentage

Data concerning the effect of nitrogen and potassium chemical fertilization on Dry matter (%) of four potato cultivars during (2014/2015) and (2015/2016) seasons are shown in Table (7). Results clearly reveal that there were significant differences among the four potato cultivars in this study in both seasons. Sponta cultivar was significantly exceeded other potato cultivars in this trait and gave (20.26 %) in the first season, and there were not differences among Brn Oceana and Chara in the first season. At the second season Oceana cv. was the first by recorded (20.29 %). There were no Significant differences between Sponta and Chara that recorded (20.25, 20.12 %) respectively. Brn cultivar was significantly less among cultivars in this trait in both seasons and this may be because it is very sensitive to the increase in the level of fertilization and this is obvious in the data. These results are in agreement with those found by **Jasem *et al.*, (1994)** who found that the cultivar surpassed in the percentage of dry matter in tubers due to genetic factors. The effect of three levels of fertilizer in this trait also presented in Table (7). The results indicated that the First level of fertilization (N90:K48) was the best level and there were not significant differences between the other two levels in this trait in both studied season. These results are in accordance with those found by **Bansal (2011**) and **Nikardi Gunadi (2009)** they showed that potassium nutrition influences dry matter content, **Samudar and Thind (2005)**

found that the dry matter of tubers was negatively affected by K application. The decrease in dry matter was probably due to dilution effect because of hydration owing to K nutrition rather than the adversely effect of on dry matter accumulation. **Forster (1981)** found that Tubers at low potassium content of the starch content decreases - and a growing proportion Alskr- a result of increased water content of tubers and this explains the superiority of class in productivity and low content of dry matter or starch. The results were in agreement with **Moosavifaz *et al*., (2001)** who reported that the effect of different N fertilizer level was insignificant on dry matter content. **Krijthe (1982)** reported that the excessive level of available N fertilizer stimulates reformation of tubers and may lead to the lengthening of tuber formation period and the difference in tubers maturity which in turn, leads to the difference in tubers dry matter content. Regarding to the combinations between chemical fertilizers and potato cultivars, data in the above mentioned table obviously reveal that the best combination was fertilize Brn cultivar with the first level of chemical fertilizer gave the highest value in both studied seasons. These results could be explained as follow, **Samudar and Thind (2005**) found that the quality characteristics including potassium, protein, dry matter and starch content in tubers were affected by K fertilization. Main while**, Yassen *et al*., (2011)** that potassium content and uptake were slightly increased with increased N applied. So with the first level of fertilization the potassium content being low and this explain what said by **Forster (1981)** who found that any cultivar high content of dry matter belongs to its low content of potassium (with the first level of fertilization) that work on decrease starch tuber content (increase sugar tuber content) which lead to increase the tuber water content. **Mehdi *et al*., (2011)** found that the effect of the interaction between cultivar and N fertilizer were significant on dry matter percentage.

Table (7) Effect of three levels of potassium and nitrogen on dry matter (percentage) of four potato cultivars grown under Sohag conditions in two successive seasons (2014\2015) and (2015\2016).

	Fertilizer levels (F)							
	First Season (2014/2015)				Second Season (2014/2015)			
Cultivars (C)	Level 1 (N90:K48)	Level 2 (N120:K90)	Level 3 (N150:K120)	Mean	Level 1 (N90:K48)	Level 2 (N120:K90)	Level 3 (N150:K120)	Mean
Sponta	22.15	18.92	19.7	20.26 A	22.44	18.6	19.72	20.25 A
Brn	24.96	16.62	15.45	19.01 B	25.96	15.23	15.72	18.97 B
Oceania	22.92	18.77	17.7	19.80 B	24.26	19.52	17.99	20.59 A
Chara	23.24	18.92	17.26	19.81 B	23.92	19.35	17.08	20.12 A
Mean	23.32^{A}	18.31^{B}	17.53^{B}		24.15^{A}	18.18^{B}	17.63^{B}	
LSD 5%	C: 1.61 F: 1.45 C x F: 2.90				C: 2.35 F: 1.78 C x F: 3.57			

7 -Starch (percentage):

Data concerning the effect of potassium and nitrogen chemical fertilization on starch (%) during (2014/2015) and (2015/2016) seasons are shown in Table (8) . Results clearly reveal that there were significant differences among the four potato cultivars in this study. Sponta cultivar was significantly higher than other potato cultivars in this trait in both seasons .While, Chara cultivar was significantly less than other cultivars in this trait in both seasons. **Jasem *et al.*, (1994)** who found that the percentage of starch belongs to the cultivar genetic factors. **Yaghbani *et al.*, (2005)** reported that there was significant difference between starch contents of different cultivars. Starch is the main compound of potato tuber, making 3/4 of dry matter and depends mostly on cultivar. It plays an important role in the quality of products and is an important factor affecting potato cooking quality **(Jafarian, 2000).** The effect of three levels of fertilizer in this trait also presented in Table (8). The results indicated the second level of fertilizer was the best level. While, the first chemical levels was the lowest level in this trait in both studied seasons. These results are in accordance with those found by **Samudar and Thind (2005**) found that the quality characteristics including starch content in tubers were affected by K fertilization. **Yassen *et al.*, (2011)** showed that increased application

levels of nitrogen, can lead to lower starch content in tubers. **Nikardi Gundi (2009)** showed that the effect of SO4 in increasing starch content was mainly due to improved translocation of metabolites to the tubers. Regarding to the combinations between chemical fertilizers and potato cultivars, data in the above mentioned table obviously reveal that the best combination was fertilize the Sponta cultivar with the second level of chemical fertilizer in both studied seasons. **Mehdi *et al.*, (2011)** found that the effect of the interaction between cultivar and N fertilizer were significant on starch percentage.

Table (8) Effect of three levels of potassium and nitrogen on starch (percentage) of four potato cultivars grown under Sohag conditions in two successive seasons (2014\2015) and (2015\2016).

	Fertilizer levels (F)							
	First Season (2014/2015)				Second Season (2014/2015)			
Cultivars (C)	Level 1 (N90:K48)	Level 2 (N120:K90)	Level 3 (N150:K120)	Mean	Level 1 (N90:K48)	Level 2 (N120:K90)	Level 3 (N150:K120)	Mean
Sponta	35.08	42.90	38.08	38.69^{A}	33.17	42.06	37.79	37.67^{A}
Brn	34.48	36.81	36.30	35.86^{B}	33.82	35.67	35.80	35.09^{B}
Oceania	22.47	24.51	21.98	22.99^{C}	22.37	24.27	21.04	22.56^{C}
Chara	18.80	24.80	19.27	20.96^{C}	18.18	25.41	19.27	20.96^{D}
Mean	27.70^{B}	32.25^{A}	28.91^{B}		26.88^{C}	31.85^{A}	28.48^{B}	
LSD 5%	C: 2.19	F: 1.31	C x F: 2.63		C: 1.47	F: 1.37	C x F: 2.74	

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