The Combination Impact of Various Rates Of (N, P, K) Fertilizers on The Critical Point Concentration and Nutrient Balance of the (NPKS) In the Local Red Onion Leaf

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Abstracts: The research was taken place in Grdarash field the experimental farm of the College of Agriculture Engineering Science, Salahaddin University Erbil . Spilt-spilt plot design was used in the field with different NPK-fertilizer applications [Nitrogen (0 , 40 , 80, 160) , Phosphorus (0 , 80 , 160) and Potassium (0 , 50 , 100) Kg ha $^{-1}$] .The amount of Macro and Micro nutrients are excessive which used in Onion crop production . Nutrient balance impacted the crop production and quality. This study aimed to know the influence of the different rates of Nitrogen, Phosphorus &Potassium on the onion-yield to establish Nutrient Indexes and critical points concentrations for the elements (N P K S) , by using foliar analysis , so we can obtain the conditions of the elements-concentration in the leaf of the crop (balance , imbalance , deficiencies , excessive). The results show that there was high Significant interaction between (N P K) elements and Onion bulb yield. The best combination between Potassium and Nitrogen elements was (K50 N40) between Potassium and Phosphorus was (K50 P80). The treatment K_1 P_2 N_1 (K 50 , P 160 & N 40 Kg ha^{-1}) has the highest Significant Onion-yield and recorded the best interaction between the (Nitrogen , Phosphorus , Potassium) elements .The critical concentration points for the Nutrients (N P K S) were (2.65 , 0.10 , 2.14 , 1.36) % respectively . The N-indexes, P-indexes, K- indexes and S-indexes ranged from (- 20.18 to 21.38) , (- 27.30 to 17.07) , (- 20.61 to 14.55) , (- 11..22 to 23.11) respectively .

Keywords: Critical Point, Nutrient Index, Balance, Onion

1. INTRODUCTION

Onion (*Allium cepa* L.) is a member of the *Alliaceae* family and is one of the most eminent economic crops in the world whose is ranked second to tomatoes, therefore it has been intensively cultivated by farmers in Iraq and many countries . This crop has different uses as food, medical using and source of income & employment opportunities that contribute significantly to the economic development [1] . The most important character of Onion is its flavor , which used to increase the taste of different types of food Onions contains phytochemical compounds such as (phenolics and flavonoids) the basic research shows to have potential Anti – inflammatory , anti – cancer , anti – oxidant & anti – cholesterol properties. One of the efforts have been done to increase the production and quality of the onion bulbs yields fertilizing the crops to increase the availability of elements. However, these efforts often do not provide the expected- improvement in yield because of several factors, such as addition inappropriate fertilization without considering the condition of the plants [2] & [3].

The application of balanced (NPK) is very much needed by younger plants because those macronutrients can stimulate plants vegetative-growth. Nitrogen is an essential- constituent of various enzymes &the protein content of vegetative plant organs also storage tissue maybe impacted by applying it. Nitrogen excess encourages exuberant-vegetative growth of the plant by (protein synthesis & the water content) and reductions Onion resistance to diseases and bulb quality but the application of (N 67 Kg ha $^{-1}$) produced the highest economic bulbs[4] .

Potassium plays avital role in plant metabolism besides improving bulb quality of onion and regulation of plant pores [5] .

Phosphorus essential nutrient because it is the storage and transfer of energy and the most important structural component of the plant.[6] .

Tow farm tests takes place in two seasons in Egypt by using split plot design with three replicates and by four levels (100% , 75% , 50% 25%) of recommended (N.P.K) fertilizer (120 N , 45 P_2O_5 & 50 K_2O Kg .ha^{-1}) , From the results we observed that highest Onion-yield was at addition of 100% of NPK-fertilizer, while the lowest was at addition of 25% of NPK-fertilizer [7] .

Research was conducted by [8] to study the influence of four rates of Nitrogen (0 , 50 , 100 and 150 kg N ha^{-1}) , three rates of Phosphorus (0 , 46 & 92 kg P2O5 ha^{-1}) & four rates of Potassium (0 , 40 , 80 , and 120 kg K2O ha^{-1}) with (Randomized Incomplete Block Design) with three replications . Results of the research shows that the addition of NPK-fertilizer had highly significant influence on Onion-yield and its parameters . The higher production (18.78 *Mg* ha^{-1}) was obtained with level (150 N : 92 P : 120 K Kg ha^{-1}) .

The Nutrient-index values suggest which element is the most limiting in the crop , and also can provide the limiting sequence of all the nutrients, so DRIS is a tool of calculations by which nutrient concentration ratios of tissue in a sample are compared to the Optimum-values of the same ratios in a High Yielding. This tool gives an indices for each element, which is a mean of the deviations of the ratios containing a given nutrient from their norms values. Positive index refer to nutrition excess but Negative index refer to deficiency, and a DRIS-index of zero or near to zero indicates Nutritional Balance increased production, avoid the waste of money and mineral-resources [9].

Field experiment carried out by [10] and he explained the Adequate Concentration for Onion Crop Dry matter in the growth-stage of (mid to maturity for whole shoots) for the elements (K. Mg. S. Ca.B. Mn.) were (3.5 – 5 gm / 100gm, 0.25 -- 0.4 gm /100gm, 0.5 – 1 gm /100 gm, 1 – 3.5 gm /100gm , 25 – 75 ppm & 5 – 25 ppm) respectively .

Critical values have been widely published for several plants because it may not be applicable at virous growth-stages. Sometimes defined as the Concentration below which the specific nutrient deficiency appear. It can be defined by American Soil Science Society as the Nutrient Concentration at witch achieved 95% of maximum Relative Yield [11].

Study conducted in the field of the college of Agricultural Engineering Sciences in Erbil-IKR by [12] to know the impact of various rates of NPK-fertilizers (N 0 ,15, 30 : P 0 , 20 ,40 , 60 : K 0 , 15 , 30 Kg ha^{-1}) on the critical nutrient point and Nutrient-Balance in Chickpea . From the results the nutrient indices ranges for Nitrogen (-19.42 to 16.98), Phosphorus (-13.74 to 12.47), Potassium (-16.41 to 7.84) and Iron (-19.64 to 29.92)..The critical-point for the concentration of the elements (N , P , K , Fe)in the Chickpea crop were (3.37 , 0.86 , 1.31 and 0.03) respectively which determined by graphic-method .

2. MATERIAL AND METHOD

The study was carried out at Grdarasha field the experimental farm of the college of Agricultural Engineering Science university of Salahaddin , 3.5 Km to the south of Erbil city (36° ON, 44° 01 E) , (0411359 , 03997002 UTM) , it is 411 m above the mean sea level ,during the growth season 2020 , some chemical& physical properties of the soil explained in table (1) .

This study used a split-split design with three factors (urea 46% N, Triple supper phosphate 42 % P_2O_5 and KCL 60 % K_2O) .The fertilizer additions were Nitrogen with 4 doses , Phosphorus with 3 doses and Potassium with 3 doses ,Sulphur one dose constantly .These treatments were replicates 3 times. we have (108) experimental unit.

After finishing tillage processes and softening the surface of soil under the study the furrows prepared with the size (60 cm × 200 cm).The distance between blocks was (100 cm) and between the experimental unit (100 cm) Local hot red species of onion blubs were planted in the planting holes and planting were done on the both side of the furrows, the distance between the plants was 15 cm. Nitrogen (0, 40, 80, 160 Kg ha $^{-1}$) which equivalent to (10.434 , 20. 869 , 41.738 g urea per furrow) , Phosphorus (0, 80 ,160 Kg ha $^{-1}$) which equivalent to (22.857, 45.714 g TSP per furrow). potassium (0, 50 ,100 Kg. ha $^{-1}$) which equivalent to (10, 20 g KCL per furrow) .The NPK- fertilizers was added as two dosage 50% of the amount after three weeks from planting and the other 50% after a month of the first addition. We applied Agricultural Sulphur (99% pure Sulphur), the amount was (6 *M*g ha $^{-1}$) for all treatments which equivalent to (720 g Sulphur per furrow) constantly without distinction before planting .

Water was applied to the treatments when plants needed and the source of irrigation water was Grdarasha well, observation were made on growth and production of the bulbs and we don't observe any diseases on the crops.

At 30/6/2020 after five months from planting where the leaves are yellow& Onion bulbs are mature, onions were ready to be harvested. they were cleaned. The data collected and we used SPSS program for statical analysis. For comparing between treatment means, Tukey, multiple range test at ($p \leq 0.05$) was used .

Table 1. Chemical and Physical properties of the soil

Properties	Value	Unit
EC e	0.51	ds.m^{-1}
PH	7.9	
Organic matter	8.5	g.Kg^{-1}
Magnesium(dissolved)	1.3	Cmolc .Kg^{-1}
Calcium (dissolved)	2.7	Cmolc .Kg^{-1}
Available Sulfate	18.5	Cmolc .Kg^{-1}
Available Nitrogen	61	mg.Kg^{-1}
Available Phosphorus	4.5	mg.Kg^{-}
Available Potassium	56	mg.Kg^{-}
Texture name	Silty clay loam	

3. Plant analysis

3.1. NPKS. determination

Available sulfate by Precipitation-method explained by [13] .

Available Nitrogen by Kjeldahil method explained by [14] .

Available Phosphorus by Spectrophotometer explained by [15] .

Available Potassium by Flame photometer explained by [14] .

3.2. Critical point determination

By Graphic-method explained by [12] .

3.2. Relative Yield (RY)%

$$RY\% = \frac{\text{any treatment yield}}{\text{Maximum Yield}} \times 100$$

3.3. Norms, Nutrient-Indexes and NBI

Calculated by DRIS tool from high yielding crops explained by [16].

4. RESULTS AND DISCUSSION

The results showed that there was a significant interaction between the application of (NPK) fertilizers on the yield of onion bulbs (Figure 1) and the treatment (50 Potassium , 160 Phosphorus & 40 Nitrogen Kg ha $^{-1}$) was the best interaction of NPK- fertilizers also has the highest-significant production of onion crop (18. 357 *Mg* ha^{-1}) , followed by (50 K , 80 P , 80 N Kg ha $^{-1}$) which its production was (17.72 *Mg* ha $^{-1}$, but also from (Figure 1) the treatment (K_0 P_0 N_0) has lowest significant onion bulb-yield (10.35 *Mg* ha^{-1})followed by the experiment units (K_{100} P_0 N_0 Kg ha $^{-1}$)

These findings indicated that there were sufficient nutrient contents (NPK) in the soil that helped the plants to grow better these results of importance of NPK fertilizer for increasing growth & production of the crops were resemble with the findings of [8] and he explained that potassium played an important role in increasing vegetative growth of plants and improve the bulbs parameters which have influenced in increasing the weight of onions .

[17] observed Increasing in the bulb onion yield with Nitrogen and phosphorus fertilization because these element causes increasing in bulb-size and its weigh.

Application of Agriculture Sulphur (6 *Mg* ha $^{-1}$) constantly without distinction for all experimental units in this study duo to Sulphur in addition of being an essential nutrient it mending soil chemical and physical properties so it create suitable condition for increasing the availability of nutrients in our calcareous soil by decreasing the soil pH for a short time (because of buffer capacity of the soil) so the plants absorb the essential Macro and Micro nutrients from the soil [5] .

[18] observed that the onion- crop limiting element for Onion crop yield was (B, S, N, P, Zn) . (S, N, P, Zn) show a significant- role in increasing Onion bulb production.

From the results we observe decreasing in the production of onion crop with increasing the nitrogen-fertilizer rate from (40 to 80 and 160 Kg ha $^{-1}$) and potassium from (50 to 100 Kg ha $^{-1}$). This finding was similar with the results of [19] he explained that over fertilization reduces the plant

(profitability & competitiveness) significantly, prevents the improvement of the products quality while it becomes a barrier to achieve high-yields, due to the Nutritional Imbalances .

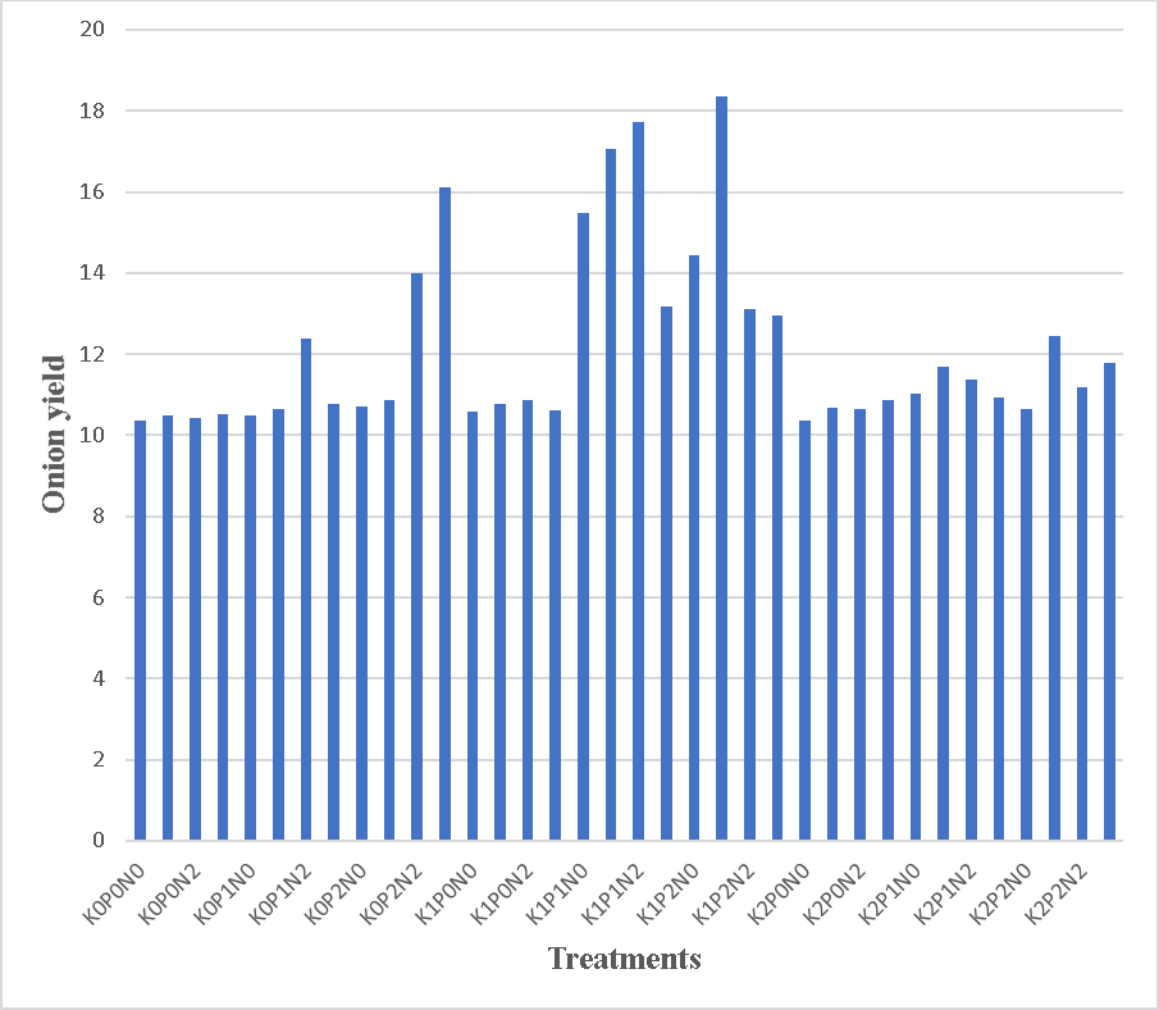


Figure 1. THE REALATIONSHIP BETWEEN NPK FERTILIZER RATES AND ONION YIELD *M*G HA $^{-1}$

From figure (2 and 3) we indicated that the best significant interaction between Potassium and Phosphorus elements was (K_1 P_1 = K 50 P 80 Kg ha $^{-1}$) , and the best significant interaction between Potassium and Nitrogen elements was (K_1 N1 = K 50 N 40 Kg ha $^{-1}$) .

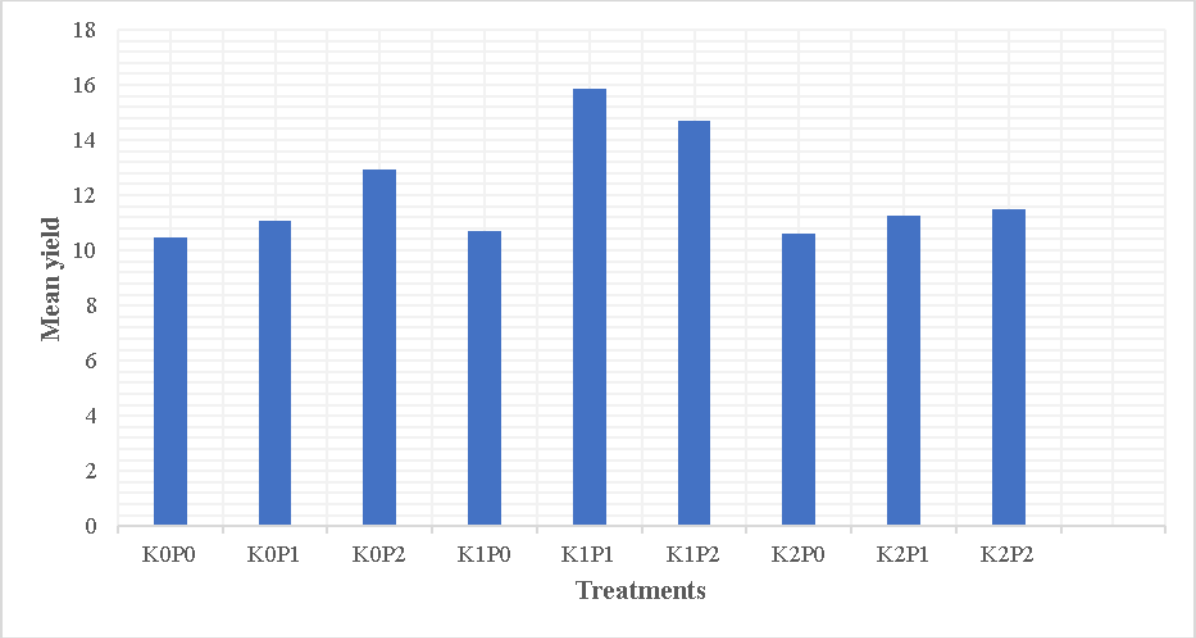


Figure 2. THE IMPACT OF POTASSIUM AND PHOSPHORUS ON ONION YIELD *M*G HA $^{-1}$

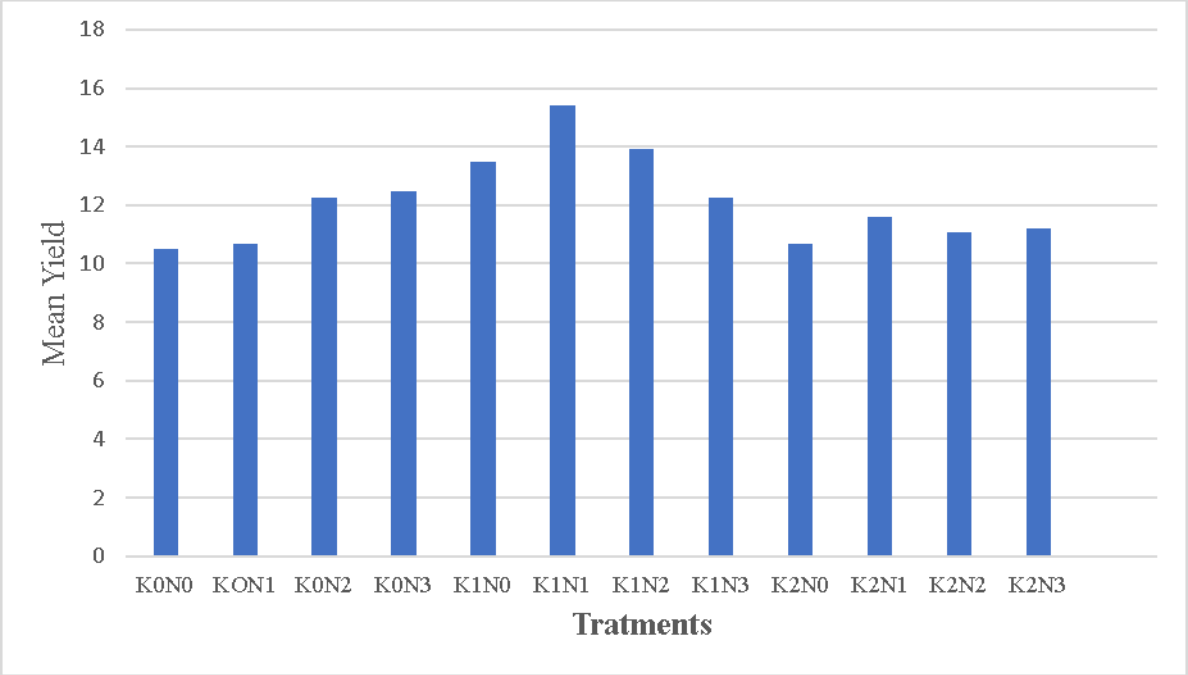


Figure 3. the impact of potassium and nitrogen on onion yield *m*g ha $^{-1}$

Table 2. DRIS index , NBI , Onion yield (*M*g ha $^{-1}$) and Relative Yield

Treatment	N-Index	P-Index	K-Index	S-Index	I	Yield	R.Y %
K0P0N0	**15.26**	**-25.47**	**-11.12**	**21.33**	**73.18**	**10.35**	**56**
K0P0N1	9.79	-2.34	-7.71	0.26	20.10	10.48	57
K0P0N2	11.04	7.68	-20.61	1.90	41.22	10.43	57
K0P0N3	-0.56	-14.96	-7.59	23.11	46.21	10.53	57
K0P1N0	-6.46	8.65	-7.23	5.04	27.38	10.49	57
K0P1N1	12.44	10.45	-13.87	-9.02	45.77	10.64	58
K0P1N2	13.79	-17.90	-15.69	19.80	67.18	12.39	67
K0P1N3	16.89	-2.42	-9.14	-5.32	33.77	10.77	59
K0P2N0	-6.33	6.48	-6.29	6.14	25.24	10.70	58
K0P2N1	21.38	-22.03	-4.07	4.72	52.20	10.88	59
K0P2N2	9.39	-5.34	-2.16	-1.88	18.78	13.99	76
K0P2N3	12.36	3.69	-6.91	-9.14	32.10	16.10	88
K1P0N0	-5.35	-15.79	4.57	16.58	42.29	10.59	58
K1P0N1	-2.11	-3.49	-1.89	7.49	14.98	10.77	59
K1P0N2	-4.12	11.03	-11.68	4.76	31.58	10.88	59
K1P0N3	4.05	-17.42	4.75	8.62	34.83	10.61	58
K1P1N0	-13.42	4.08	11.33	-1.98	30.81	15.48	84
K1P1N1	-12.82	11.03	-7.78	9.57	41.20	17.07	93
K1P1N2	4.99	-2.91	-1.11	-0.97	9.98	17.72	97
K1P1N3	1.13	-7.50	6.96	-0.59	16.18	13.17	72
K1P2N0	-20.18	12.54	0.22	7.42	40.37	14.43	79
K1P2N1	**-2.69**	**-1.01**	**-0.82**	**4.52**	**9.04**	**18.36**	**100**
K1P2N2	2.74	-9.12	6.28	0.11	18.25	13.10	71
K1P2N3	4.67	2.52	-3.29	-3.90	14.38	12.94	70
K2P0N0	-5.69	-10.49	13.21	2.97	32.36	10.36	56
K2P0N1	-4.35	0.27	-2.48	6.56	13.66	10.67	58
K2P0N2	-1.16	15.43	-3.05	-11.22	30.86	10.63	58
K2P0N3	10.93	-24.53	-2.61	16.21	54.28	10.88	59
K2P1N0	-5.48	-0.23	8.31	-2.60	16.62	11.04	60
K2P1N1	-3.68	8.57	-1.89	-3.00	17.13	11.69	64
K2P1N2	2.21	-27.30	4.62	20.47	54.60	11.38	62
K2P1N3	6.70	-7.86	4.08	-2.92	21.56	10.92	59
K2P2N0	-12.55	17.07	0.86	-5.38	35.86	10.63	58
K2P2N1	6.96	-22.83	14.55	1.33	45.66	12.44	68
K2P2N2	5.79	-24.64	10.78	8.07	49.29	11.17	61
K2P2N3	7.43	9.15	-7.35	-9.23	33.17	11.79	64

Table (2) explained Nutrient Balance Index for the elements (NPKS) it ranging from (9.04 to 73.18) , the lowest value of (NBI) was for the treatment with highest yield (18.36 *M*g ha $^{-1}$) which was for the nutrient-combination (potassium 50 , phosphorus 160 , nitrogen 40) , that means there are sufficient amount of the elements for crop growth and production this finding similar with the results of [20] .

The values of N-indexes , P-indexes , K- indexes and S-indexes ranged from (- 20.18 to 21.38) , (- 27.30 to 17.07) , (- 20.61 to 14.55) , (- 11..22 to 23.11) respectively . The number of the positive indexes of the elements (N P K S) for the 36 treatments were (20 , 15 , 13 , 22) and the negative indexes were (16 , 21 , 23 , 14) respectively , that mean the nitrogen-content in the most treatments were excessive (20 positive indexes) but the potassium and phosphorus-content were deficient (23 , 21 negative indexes respectively) .

Treatment	N-Index	P-Index	K-Index	S-Index	I	Yield	R.Y %
K0P0N0	**15.26**	**-25.47**	**-11.12**	**21.33**	**73.18**	**10.35**	**56**
K0P0N1	9.79	-2.34	-7.71	0.26	20.10	10.48	57
K0P0N2	11.04	7.68	-20.61	1.90	41.22	10.43	57
K0P0N3	-0.56	-14.96	-7.59	23.11	46.21	10.53	57
K0P1N0	-6.46	8.65	-7.23	5.04	27.38	10.49	57
K0P1N1	12.44	10.45	-13.87	-9.02	45.77	10.64	58
K0P1N2	13.79	-17.90	-15.69	19.80	67.18	12.39	67
K0P1N3	16.89	-2.42	-9.14	-5.32	33.77	10.77	59
K0P2N0	-6.33	6.48	-6.29	6.14	25.24	10.70	58
K0P2N1	21.38	-22.03	-4.07	4.72	52.20	10.88	59
K0P2N2	9.39	-5.34	-2.16	-1.88	18.78	13.99	76
K0P2N3	12.36	3.69	-6.91	-9.14	32.10	16.10	88
K1P0N0	-5.35	-15.79	4.57	16.58	42.29	10.59	58
K1P0N1	-2.11	-3.49	-1.89	7.49	14.98	10.77	59
K1P0N2	-4.12	11.03	-11.68	4.76	31.58	10.88	59
K1P0N3	4.05	-17.42	4.75	8.62	34.83	10.61	58
K1P1N0	-13.42	4.08	11.33	-1.98	30.81	15.48	84
K1P1N1	-12.82	11.03	-7.78	9.57	41.20	17.07	93
K1P1N2	4.99	-2.91	-1.11	-0.97	9.98	17.72	97
K1P1N3	1.13	-7.50	6.96	-0.59	16.18	13.17	72
K1P2N0	-20.18	12.54	0.22	7.42	40.37	14.43	79
K1P2N1	**-2.69**	**-1.01**	**-0.82**	**4.52**	**9.04**	**18.36**	**100**
K1P2N2	2.74	-9.12	6.28	0.11	18.25	13.10	71
K1P2N3	4.67	2.52	-3.29	-3.90	14.38	12.94	70
K2P0N0	-5.69	-10.49	13.21	2.97	32.36	10.36	56
K2P0N1	-4.35	0.27	-2.48	6.56	13.66	10.67	58
K2P0N2	-1.16	15.43	-3.05	-11.22	30.86	10.63	58
K2P0N3	10.93	-24.53	-2.61	16.21	54.28	10.88	59
K2P1N0	-5.48	-0.23	8.31	-2.60	16.62	11.04	60
K2P1N1	-3.68	8.57	-1.89	-3.00	17.13	11.69	64
K2P1N2	2.21	-27.30	4.62	20.47	54.60	11.38	62

K2P1N3	6.70	-7.86	4.08	-2.92	21.56	10.92	59
K2P2N0	-12.55	17.07	0.86	-5.38	35.86	10.63	58
K2P2N1	6.96	-22.83	14.55	1.33	45.66	12.44	68
K2P2N2	5.79	-24.64	10.78	8.07	49.29	11.17	61
K2P2N3	7.43	9.15	-7.35	-9.23	33.17	11.79	64

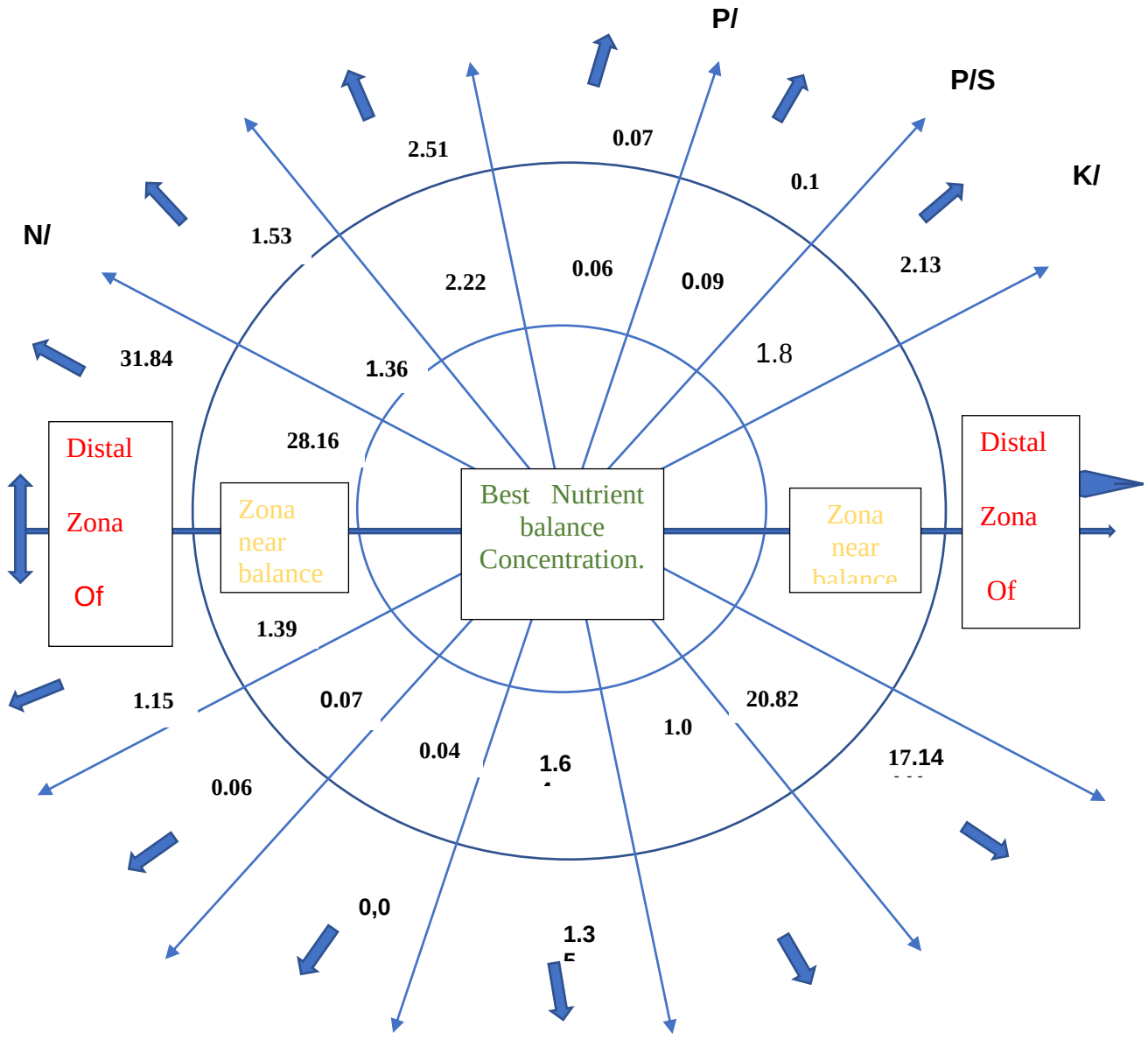
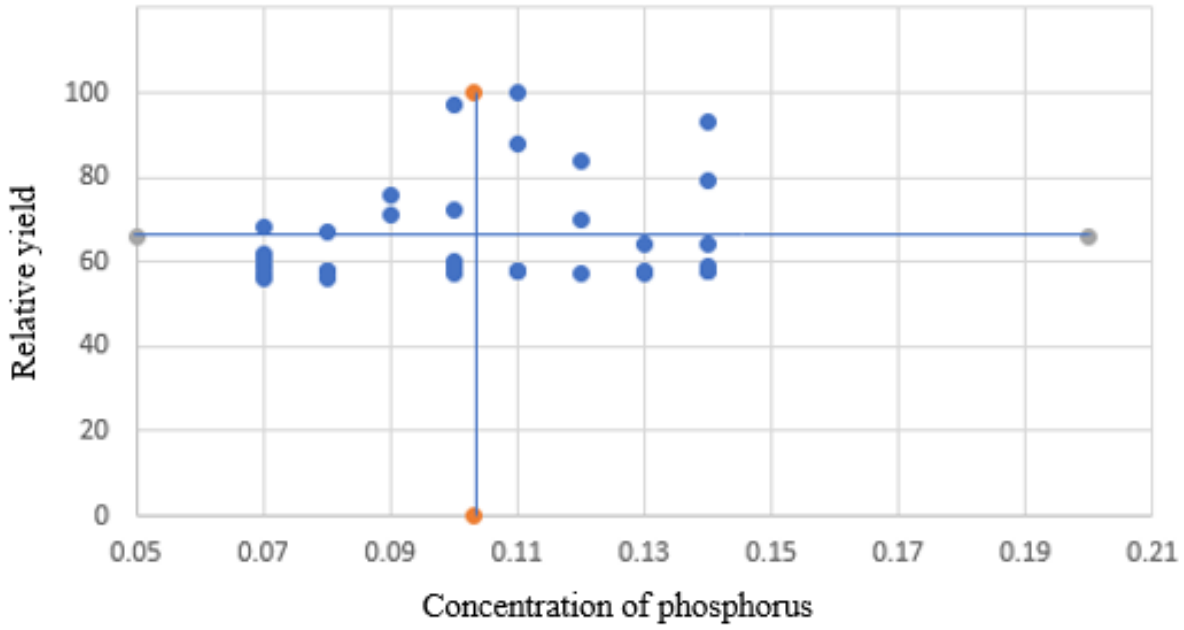


FIGURE 4. THE NORMS AND THE TYPES OF NUTRIENT BALANCE IN ONION CROP

Table 3. The optimum and critical value for nutrients ratios in Onion crop

Limit of confidence	N/P	N/K	N/S	P/K	P/S	K/S
+30%	31.84	1.53	2.51	0.07	0.10	2.13
+15%	28.16	1.36	2.22	0.06	0.09	1.89
Norms	**24.49**	**1.18**	**1.93**	**0.05**	**0.08**	**1.64**
-15%	20.82	1.00	1.64	0.04	0.07	1.39
-30%	17.14	0.83	1.35	0.03	0.06	1.19



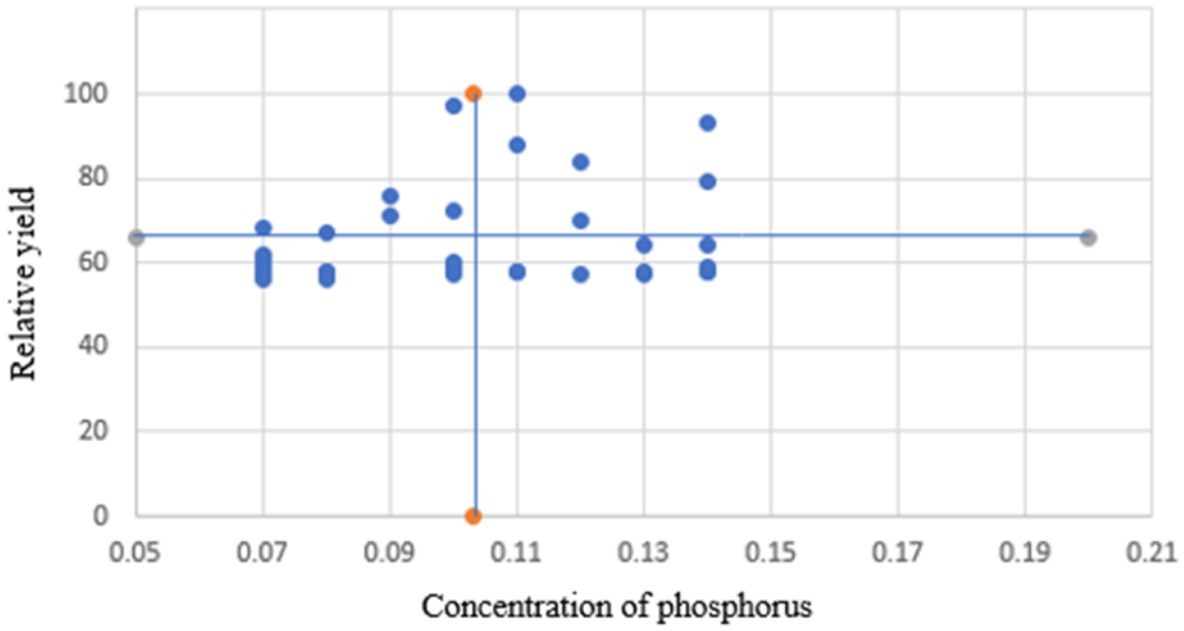


Figure 5 . the critical concentration point of phosphorus and (ry%)

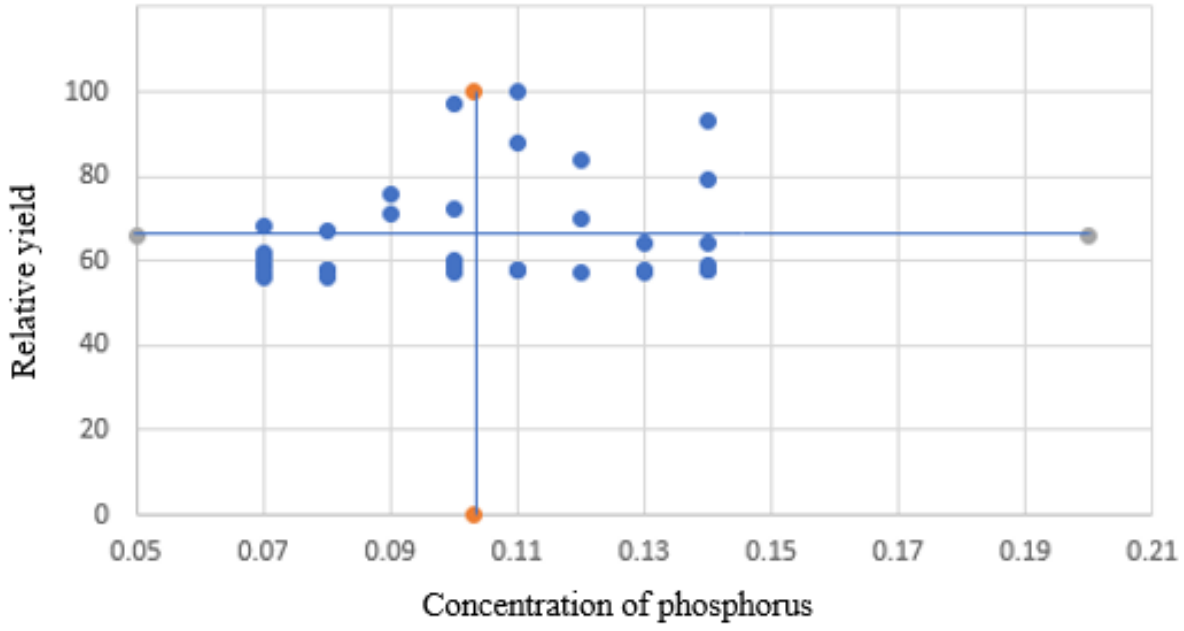


Figure 6. The critical concentration point of phosphorus and (RY%)

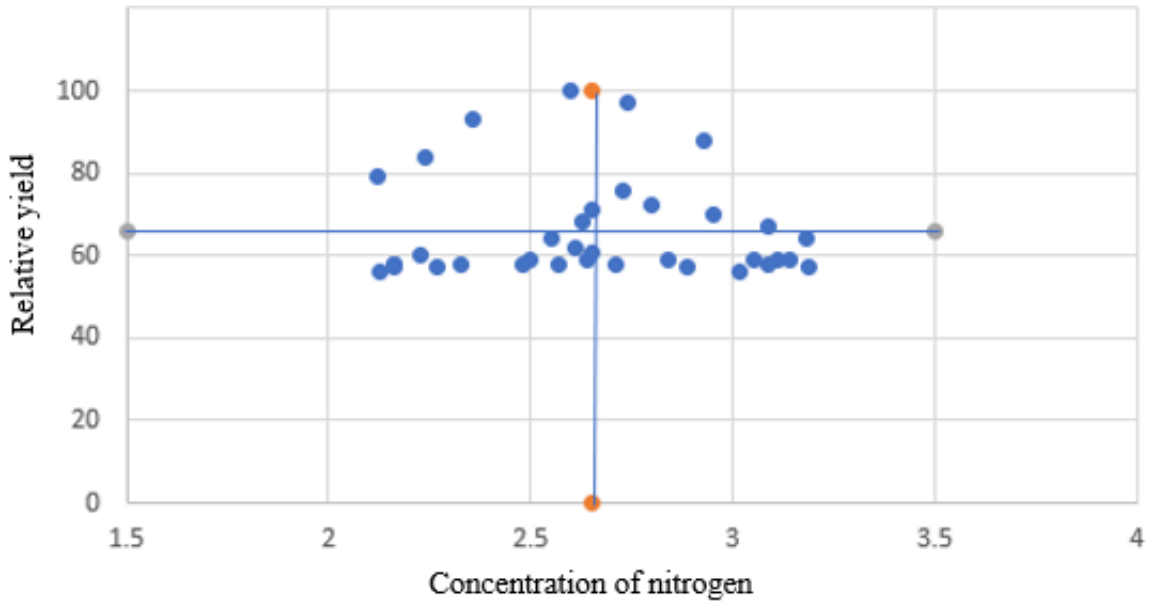


FIGURE 7. THE CRITICAL CONCENTRATION POINT OF NITROGEN AND (RY %)

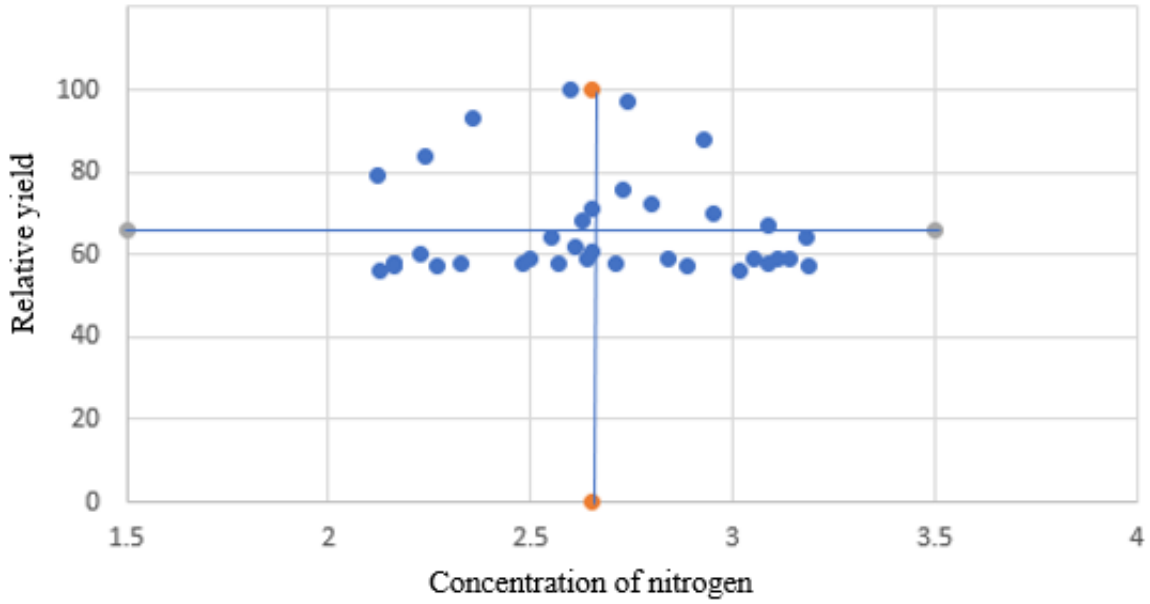


Figure 8 . The criticalcon centration point of sulfur and (RY %)

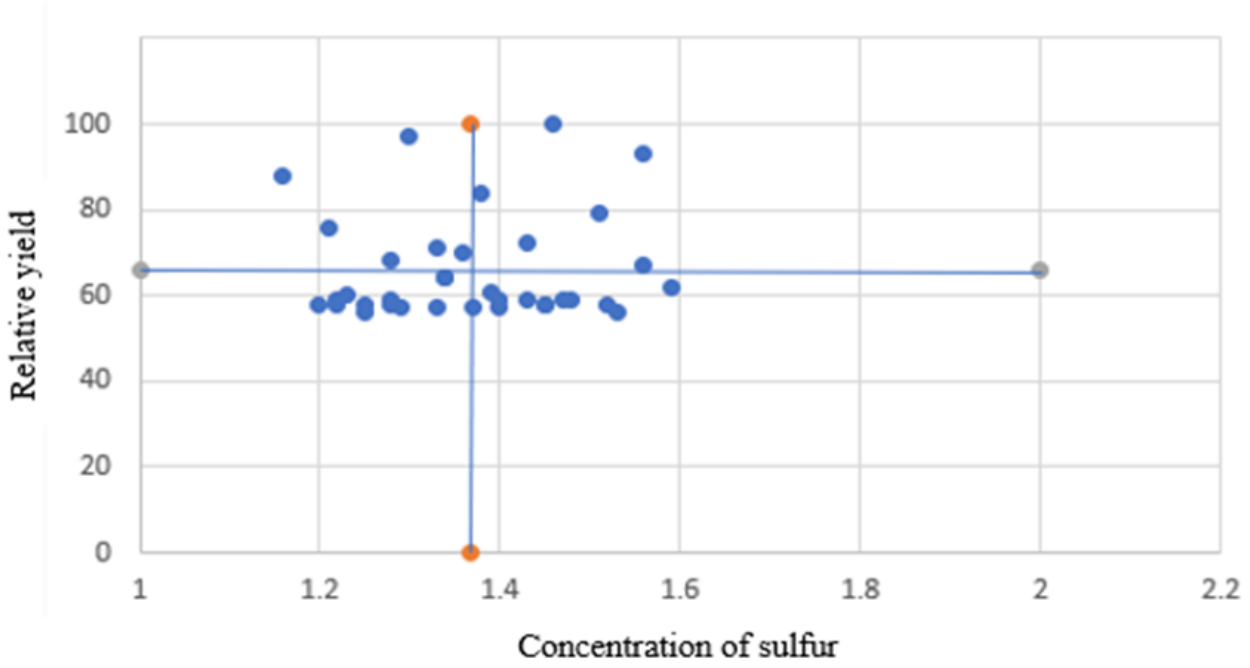


Figure (8) the criticalcon centration point of sulfur and (ry %)

Table (3) shows the (N P K S) nutrients norms and the limits of confidence .From the figure (4) we can indicate the types of nutrient-balance .From the figures (5 – 8) the critical nutrient concentration point for the elements (K P N S) were (2.14 , 0.10 , 2.65 , 1.36 %) respectively .

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