Influence of Cobalt and Different Organic Fertilizers on Chickpea Production

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ABSTRACT
Two field experiments were carried out to study the efficiency of cobalt and different organic fertilizers. Experiments were conducted at Agricultural Experimental Station of the National Research Centre at Nubaria, Beheira Governorate Egypt, in two successive seasons 2017/2018 and 2018/2019 under drip irrigation system. The obtained results are summarized in the following: The greatest chickpea growth and yield parameters were attained in plants with treated with chicken manure followed by farmyard manure while agriculture compost was the lowest ones. Application cobalt at 12 ppm to all studied organic fertilizers enhancing chickpea nodulation rate, growth and seeds yield quantity and its quality. The superior chickpea growth and yield parameter were attained in plants which supplied with cobalt at 12 ppm with chicken manure followed by farmyard manure while cotton compost resulted the lowest ones.

Keywords: Chickpea, Cobalt, Organic Fertilizers, Seed Yield and Quantity

1. Introduction
Legumes play an important role in human nutrition, science they are rich source of protein, calories, certain minerals and vitamins. Legumes are the major contributors of protein and calories for economic and cultural reasons (Tgungula and Garjila, 2006). Chickpea (Cicer arietinum L.) is a rich source of quality protein for the rural poor and vegetarian populations. It enhances the nutritional value of cereal dominated diets, as protein contents in Chickpea nearly twice as high as that in cereals.

Soils of Egypt are poor in organic matter exceeding 2% (Balba, 1976). To conserve their low level of organic matter. Egyptian soils should receive about 82 million tons annually (Riad, 1982). With increasing the cost of mineral fertilizers and questions as to their future availability, there is renewed interest in organic fertilizers especially organic recycling to improve soil fertility and productivity (Parr and Hornick, 1990). Abdel-Sabour et al., (1996) added that previous organic waste composts significantly increased sunflower dry matter and seeds yield as well as seeds minerals composition.

Cobalt is a beneficial element for higher plants, although there is no evidence of the direct role. Cobalt is an essential element for legumes due its essentiality for micro-organisms fixing atmospheric nitrogen (Evans and Kliver, 1964). Cobalt is a central atom of vitamin B₁₂ structural. Vitamin B₁₂ is essential water – soluble vitamin. Vitamin B₁₂ is valuable for human and animal nutrition. Unlike other heavy metals, cobalt is sauer for human consumption and up to 8 ppm can be consumed on a daily basis without health hazard (Young, 1983). With the increasing in age cobalt does not accumulate in human body as the other heavy metals (Smith, 1991).
Angelove et al., (1993) found that, cobalt increased chlorophyll synthesis and photosynthesis rate. Cobalt stimulates the growth and development of pea plants. Jana et al., (1994) stated that better nodulation due to proper doses of cobalt resulted in better growth and yield of groundnut plants. To increase cobalt uptake by the wheat plants grown on sandy loam soil, it should be supplied with nitrogen (Bibak 1994). This response was higher when receiving farmyard manure (FYM) than in the untreated field. Ismail et al., (1996) showed that cattle manure at rates 8% increased the availability and uptake of Co, Cu, Zn and Fe by maize plants. Watson and Savard (2001) pointed that cobalt significantly increased plant height, root dry weights, leaf area index, dry matter accumulation in shoot parts as well as pods yield in both cowpea and groundnuts compared with the control. Balachandar et al., (2003) pointed that cobalt is a necessary element to legumes. In particular for growth and yield of blackgram. Nadia Gad (2006 b) reported that the addition of cobalt in pea plant media magnified the benefit of nutrients uptake by plants. Cobalt also increased both fresh and dry weights of shoots and roots, nodules number and weight, content of macronutrients, micronutrients as well as yield, pods and seeds quality of pea plants.

Jayakumar et al., (2009) found that cobalt at 50 mg kg\(^{-1}\) soil has a significant positive effect on soybean growth and nutrient absorption. Nadia Gad et al., (2014) showed that cobalt at 12 ppm significantly increased nitrogenase enzyme activity which was parallel related to the increase nodules number and weight, minerals status in soybean seeds especially with 100% and 75% nitrogen. Finally, the additions of cobalt at 12 ppm to the soil save 25% nitrogen fertilizer compared with untreated soybean plants. Nadia Gad and Ali (2016) pointed that, the application cobalt of cobalt at 8 ppm with different sources of organic fertilizers significantly enhancing pea growth, seeds yield quantity and its quality. Jayakumar et al., (2018) show that all minerals composition of blackgram was increased as cobalt addition to soil increased compared with control plants. The highest values of Mn, Zn and Cu in blackgram seeds with cobalt at 50 mg/kg soil.

This work aimed to study the effect of cobalt and different organic fertilizers on chickpea growth, seeds yield quantity and quality.

2. Materials and Methods

2.1. Experiment layout

Two experiments were carried out to determine the effect cobalt and different organic fertilizers on the growth, yield quantity and quality of chickpea, during the two successive seasons of 2017/2018 and 2018/2019 at the Agricultural Experimental Station of the National Research Centre at Nubaria, Beheira Governorate, Egypt. The experiment was established with a split-plot design having four replicates. The main plots included cobalt treatments (cobalt at the rate of 12 ppm/L and without cobalt). Subplots were assigned to four different organic fertilizers (Control: received only recommended doses by Ministry of Agriculture of mineral fertilizers, chicken manure (33.5 N unit), farmyard manure (33.5 N unit) and cotton compost waste (33.5 N unit)).

Plot area was 15 m\(^2\) (3 m width by 5 m length), containing 5 ridges spaced 60 cm apart.

2.2. Soil analysis

Physical and chemical properties of Nubaria soil samples were determined as well as particle size distributions and soil moisture were determined as described by Blackmore et al., (1972). Soil PH, EC, cations and anions, organic matter, CaCO\(_3\), total nitrogen and available P, K, Fe, Mn, Cu were run according to Black et al., (1982). Determinations of soluble, available and total cobalt were determined according to method described by Cottenie et al., (1982). Some physical and chemical properties of Nubaria soil sample are shown in Table (1).

Calcium super phosphate (15.5%) at the rate of 150 kg P\(_2\)O\(_5\)/fed and potassium sulphate (48 % K\(_2\)O\(_2\)) at the rate of 100 kg/fed as well as studied organic fertilizer were added during soil preparation. A seed of chickpea (Giza 1) was inoculated prior to sowing with a specific strain of rhizobium. Seeds were sown on mid-November, in the two seasons.

All required agricultural managements for plants growth and production were carried out as recommended by Ministry of Agriculture. Some properties of different organic fertilizer sources used in the studies experiments are given in Table (2).
Table 1: Physical and chemical analysis of the experimental soils in Nubaria Station.

| Particle size distribution | Soil texture | Saturation | Soil moisture constant % |
|---------------------------|--------------|------------|-------------------------|
| Sand                      | Silt         | Clay       | FC                      |
| 69.8                      | 26.7         | 3.5        | 20                      |

| Soil texture | FC | WP | AW |
|--------------|----|----|----|
| Sandy loam   | 14.4 | 3.9 | 10.5 |

| pH | EC (dS m⁻¹) | Caaco³ | OM % | Soluble cations (meq⁻¹L) | Soluble anions (meq⁻¹L) |
|----|-------------|--------|------|--------------------------|-------------------------|
| 8  | 1           | 3.17   | 0.19 | Ca⁺⁺                     | Mg⁺⁺                    |
|    |             |        |      | 0.8                       | 1.4                     |
|    |             |        |      | K⁺                       | Na⁺                     |
|    |             |        |      | 5.4                       | 3.26                    |
|    |             |        |      | HCO₃⁻                    | CO₃⁻                    |
|    |             |        |      | -                         | -                       |
|    |             |        |      |                           | 1.18                    |
|    |             |        |      |                           | 6.6                     |
|    |             |        |      |                           | 2.4                     |

| Cobalt | Total  | Available | Available micronutriments |
|--------|--------|-----------|--------------------------|
| Soluble | ppm    | mg 100 g⁻¹ soil | ppm        |
| 0.39   | 1.78   | 9.68       | 25.2                   |
|        | 15.3   | 10.2       | 23                     |
|        | 10.5   | 3.62       | 5.22                   |

Table 2: Some chemical properties of the studied organic fertilizers source

| Organic source    | PH (1:10) | EC (dS m⁻¹) | C/N ratio | OM (%) | Total Nitrogen (%) | % | ppm          |
|-------------------|-----------|-------------|-----------|--------|--------------------|---|--------------|
| Chicken manure    | 6.40      | 2.72        | 13.70     | 28.1   | 1.88               | 0.836 | 0.938 486 |
| Farmyard manure   | 6.83      | 4.10        | 14.72     | 27.2   | 2.06               | 0.930 | 0.859 469 |
| Cotton compost    | 6.01      | 3.42        | 11.78     | 23.8   | 1.82               | 1.138 | 0.987 451 |

2.3. Measurement nodulation parameters

After 50 days from sowing, nodulation rate was record i.e. number of both total and active nodules as well as its biomass. Also nitrogenase enzyme was determined according to Hardy et al., (1968).

2.4. Measurement of plant vegetative growth:

After 60 days from sowing to study the vegetative growth parameters expressed as plant height, number of branches and leaves, leaves area, root length as well as fresh and dry weights of both shoots and roots according to FAO (1980).

2.5. Measurement of yield and yield attributes

At harvest, yield and yield attributes such as number of pods per plant, pod length, pod width, fresh weight of 100 seeds and total yield (ton/fed) were determined according to Gabal et al., (1984).

2.6. Measurements of Nutritional status

In chickpea seeds, macronutrients (N, P and K) and micronutrients (Fe, Mn, Zn and Cu) as well as cobalt content were determined according to cottonie et al., (1982).

2.7. Measurement of Chemical constituents

In chickpea seeds, total proteins, total carbohydrates, total soluble sugars, total soluble solids as well as vitamins A and C were determined according to A.O.A.C (1995).

2.8. Statistical Analysis

Data were subjected to analysis of variance (ANOVA) according to Gomez and Gomez (1984) using Costat software program Version 6.303 (2004). The combined analysis of variance for the data of the two seasons was performed. The differences among means were compared using LSD test at 5% level of probability.

3. Results and Discussion

3.1. Nodulation parameters

Data presented in Table 3 show significant increases of all the studied traits. Application of cobalt at 12 ppm/L led to the significantly increased maximum values of total nodules/plant (number
and fresh weight), Active nodules/plant (number and fresh weight) and Nitrognase Mmol (C₂H₂/(gm)h. These results are in harmony with those obtained by Nasef et al., (2008) they found that cobalt at 0.16 g⁻¹ level had a significant higher nodule number and weight, nodule nitrogen content, leghemoglobin content, total biomass production and seeds yield of peanut compared with control. In this connection, cobalt vital role accompanied with the increase of nitrogenase enzyme activity.

All organic fertilizers treatments increased nodulation parameters compared with control treatment (NPK) (Tab. 3). Application of chicken manure led to the significantly increased the highest values of previous characters compared with other treatments, while farmyard manure was the second most effective fertilizer treatment. Cotton compost resulted in the lowest values of total nodules/plant (number and fresh weight), Active nodules/plant (number and fresh weight) and nitrogenase Mmol (C₂H₂/(gm)h).

Table 3: Chickpea nodulation and some growth parameters as affected by cobalt under different organic fertilizers (Mean of two seasons).

| Characters | Cobalt: | Fertilizers | F. test | LSD at 5% |
|------------|---------|-------------|---------|-----------|
| Treatments | With cobalt | Without cobalt | Control (NPK) | Chicken manure | Farmyard manure | Cotton compost | | | |
| Total nodules/plant | Number | Fresh weight | Number | Fresh weight | Nitrognase Mmol (C₂H₂/(gm)h) | Plant height | Branches | Leaves | Number/plant |
| | With cobalt | Without cobalt | With cobalt | Without cobalt | With cobalt | Without cobalt | | | |
| | 47.28 | 3.71 | 19.39 | 2.06 | 20.93 | 30.73 | 7.50 | 17.25 | |
| | 35.98 | 2.90 | 13.84 | 1.48 | 16.88 | 28.63 | 6.25 | 15.75 | |
| | * | * | * | * | * | NS | * | * | |
| Fertilizers | Control (NPK) | Chicken manure | Farmyard manure | Cotton compost | | | | | |
| | 37.60 | 3.05 | 15.08 | 1.69 | 17.55 | 28.85 | 6.50 | 16.00 | |
| | 50.70 | 4.09 | 21.56 | 2.21 | 21.60 | 33.10 | 8.00 | 19.50 | |
| | 45.20 | 3.56 | 17.80 | 1.86 | 19.55 | 31.05 | 7.50 | 18.00 | |
| | 33.00 | 2.53 | 12.03 | 1.34 | 16.90 | 25.70 | 5.50 | 12.50 | |
| LSD at 5% | 3.12 | 0.31 | 3.14 | 0.22 | 0.92 | 2.17 | 0.34 | 1.23 | |

Significant interactions were found between cobalt and organic fertilizers on the total nodules/plant (number and fresh weight) Table 4. The application of cobalt at the rate of 12 ppm/l resulted in the maximum values of aforementioned when chicken manure was used. In this regard, cobalt vital role accompanied with the increase of nitrogenase enzyme activity with all studied organic fertilizers. Cobalt recorded the best rate with chicken manure while the lowest values with cotton compost. These results are good agreement with those obtained by Epstein (1972) who stated that cobalt as Co-enzyme chelated to four nitrogen atoms at the centre of a prophyrin structure similar to that of iron in hemin. In rhizobium species, enzymes are primary responsible for the relationship to nodulation and atmospheric nitrogen fixation in legumes.

Table 4: Effect of the interactions (cobalt and organic fertilizers) on number and fresh weight of total nodules in chickpea (Mean of two seasons).

| Treatments | Characters | Number of total nodules | Fresh weight of total nodules |
|------------|------------|-------------------------|------------------------------|
|            |            | With cobalt | Without cobalt | With cobalt | Without cobalt |
| Fertilizers: |            |            |                |                |                |                |
| Control (NPK) | 41.20 | 34.00 | 3.36 | 2.73 |
| Chicken manure | 58.6 | 42.80 | 4.55 | 3.62 |
| Farmyard manure | 52.3 | 38.10 | 4.05 | 3.07 |
| Cotton compost | 37.00 | 29.00 | 2.87 | 2.19 |
| LSD at 5% | 0.96 | 0.78 | | |

3.2. Vegetative growth

Chickpea growth parameters as affected by cobalt and different organic fertilizers after 75 days from sowing are given in Table (3 and 5). The results in Tables, 3 and 5 indicate that Co at the rate of 12 ppm gave the highest values of plant height, number of leaves and fresh weight of both of shoot compared with without Co.
Chicken manure was the most effective treatment resulting in increasing chickpea plant height, number of leaves, number of branches, fresh and dry weight of both shoots and roots (Tables 3 and 5). Moreover, farmyard manure treatment was statistically at par with chicken manure for improving these chickpea growth characters.

Table 5: Chickpea some growth parameters and yield attributes as affected by cobalt under different organic fertilizers (Mean of two seasons).

| Characters | Fresh weight /plant | Dry weight /plant | Pods | 100 seeds Weight (g) | Seeds yield ton/fed |
|------------|---------------------|-------------------|------|---------------------|---------------------|
|            | Shoot | Root | Shoot | Root | Number | Weight | Length | Width |                   |                     |
| With cobalt | 33.93 | 4.57 | 5.35 | 1.25 | 22.00 | 25.28 | 4.50 | 0.83 | 21.50 | 1197.53 |
| Without cobalt | 31.10 | 4.26 | 4.93 | 1.19 | 19.80 | 23.40 | 4.30 | 0.73 | 20.28 | 1092.72 |
| F. test     | *     | NS   | NS   | 1.02 | 1.21 | NS     | NS    | 0.65 | 23.11 |

Data in Table 6 show that there was a significant effect due to the interaction between cobalt and organic fertilizers on plant height and dry weight of shoot. Cobalt at the rate of 12 ppm significantly increased previous parameters when chicken manure was applied compared with the other treatments. In this connection, the smallest aforementioned parameters were recorded with the cotton compost treatment and without cobalt. These observation are consistent with previous reports obtained by Nadia Gad (2006 a) who found that cobalt being with positive effect due to several induced effects in hormonal synthesis and metabolic activity, while it’s reduce the activity of some enzymes such as peroxidase and catalase in tomato plants and hence increasing the anabolism rather than catabolism. Confirm these results Bibak (1994) who added that, winter wheat treated with cobalt and farmyard manure responses the higher growth compared with control (N, P and K).

Table 6: Effect of the interactions (cobalt and organic fertilizers) on plant height and dry weight of shoot in chickpea (Mean of two seasons).

| Treatments | Characters | Plant height | Dry weight of shoot |
|------------|------------|--------------|---------------------|
|            | With cobalt | Without cobalt | With cobalt | Without cobalt |
|            | Fertilizers: |              |                      |                  |
| Control (NPK) | 30.40 | 27.3 | 5.27 | 4.81 |
| Chicken manure | 34.20 | 32.0 | 5.88 | 5.50 |
| Farmyard manure | 31.90 | 30.2 | 5.63 | 5.13 |
| Cotton compost | 26.40 | 25.0 | 4.62 | 4.29 |
| LSD at 5%    | 1.12 | 0.32 |

3.3. Yield characteristics

The data in Table 5 reveal that cobalt treatment significantly increased pods number per plant, pods weight per plant, pod length, 100 seeds weight and seeds yield (ton/fed) as compared to the without cobalt treatment. These data are in harmony with those obtained by Nadia Gad et al., 2014 who stated that the lower doses of cobalt resulted in maximum growth and yield of tomato and cucumber plants as compared with the higher ones. They reported that responses associated with low cobalt levels may be attributed to catalase and peroxidase activities which were found to decrease with low levels of cobalt and increase with the higher ones. These enzymes are known to induce plant respiration, so superior resulting in successive consumption for products of photosynthesis and consequently reduced in plant growth. Moreover, low cobalt levels being with positive effect due to several induce the effects in hormonal synthesis and metabolic activity.
Data in Table (5) show that both chicken manure and farmyard manure significantly increased yield and yield attributes parameters of chickpea such as pods number per plant, pods weight per plant, pod length and 100 seeds weight. Concerning the effect of organic fertilizers on yield, all organic fertilizers plots produced more yield over the cotton compost treatment. Applying chicken manure and farmyard manure resulted in increases in the seed yields by 11.94 and 6.83 over the cotton compost, respectively (Table 5). While cotton compost resulted the lowest ones. This may explained on the basis of results reported by Ogunlele et al., (2005) they stated that chicken manure improve the growth, yield and its attributes of lettuce compared with untreated plants.

Cobalt and organic fertilizers were markedly interacted in affecting most studied traits of chickpea yield in Table 7. In this regard, cobalt at the rate of 12 ppm significantly increased pods weight, 100 seeds weight and seed yield in chickpea when chicken manure was applied compared with the other treatments. These results are agree with those obtained by Nadia Gad et al., (2006 c) they stated that olive yield resulted the higher values with cobalt at 22.5 ppm and farmyard manure compared with control under Rass seder conditions.

Table 7: Effect of the interactions (cobalt and organic fertilizers) on pods weight, 100 seeds weight and seed yield in chickpea (Mean of two seasons).

| Characters | Treatments | Pods weight | 100 seeds weight | Seed yield |
|------------|------------|-------------|------------------|------------|
|            |            | With cobalt | Without cobalt   | With cobalt | Without cobalt |
| Fertilizers: |           |             |                  |             |               |
| Control (NPK) |            | 25.40       | 23.50            | 20.90       | 19.20         | 988.70       | 955.80       |
| Chicken manure |            | 28.50       | 25.60            | 24.20       | 23.00         | 1350.30      | 1179.60      |
| Farmyard manure |            | 26.80       | 24.50            | 22.50       | 21.00         | 1274.50      | 1146.20      |
| Cotton compost |            | 20.40       | 20.00            | 18.40       | 17.90         | 1176.60      | 1089.40      |
| LSD at 5% |            | 2.13        | 1.22             | 47.15       |               |              |              |

3.4. Nutritional status

Data in Table (8) also indicate that the addition of cobalt in plant media significantly increased the content of macronutrients (N) and micronutrients (Fe, Mn, Zn and Cu). These results are confirmed by Jana et al., (1994) they pointed that cobalt application resulted the better status of all minerals in groundnut seeds compared with control. Jayakumar et al., (2018) added that as cobalt addition to soil, all nutrients status of blackgram significantly increased. The high values of seeds content with cobalt at 50 mg/ kg soil.

Table 8: Nutritional status in chickpea seeds as affected by cobalt under different organic fertilizers (Mean of two seasons).

| Characters | Treatments | Macronutrients (%) | Micronutrients (ppm) | Cobalt (ppm) |
|------------|------------|--------------------|----------------------|--------------|
|            |            | N                 | P                    | K            | Mn          | Zn          | Cu          | Fe          |
|            |            |                   |                      |              |             |             |             |             |
|            |            | With cobalt       | Without cobalt       | With cobalt  | Without cobalt |
|            |            | 3.47              | 0.397               | 1.54         | 29.33       | 22.70       | 27.75       | 166.50      | 5.44        |
|            |            | 2.83              | 0.392               | 1.32         | 27.08       | 20.18       | 24.55       | 180.75      | 1.20        |
|            |            |                   |                      |              |             |             |             |             |             |
|            |            | *                 | NS                  | *            | *           | *           | *           | NS          | *           |
|            |            |                   |                      |              |             |             |             |             |             |
|            |            |                   |                      |              |             |             |             |             |             |
| F. test    |            | *                 | NS                  | *            | *           | *           | *           | NS          |
| Fertilizers |           |                   |                      |              |             |             |             |             |             |
| Control (NPK) |            | 3.01              | 0.365               | 1.36         | 28.20       | 20.40       | 25.05       | 175.00      | 3.13        |
| Chicken manure |            | 3.69              | 0.452               | 1.72         | 31.25       | 24.90       | 29.95       | 177.00      | 4.46        |
| Farmyard manure |            | 4.98              | 0.397               | 1.60         | 28.40       | 22.10       | 27.70       | 170.00      | 3.58        |
| Cotton compost |            | 2.45              | 0.364               | 1.06         | 24.95       | 18.35       | 21.90       | 172.50      | 2.87        |
| LSD at 5% |            | 0.22              | 0.023               | 0.11         | 2.12        | 1.21        | 2.01        | NS          | 0.23        |

These results in Table 8 illustrate the significant impact of organic fertilizers treatments on nutritional status. Chicken manure recorded the highest content of both macronutrients and micronutrients in chickpea seeds except Fe followed by farmyard manure. Cotton compost gave the lowest values. These results are agree with those obtained by Nanwai et al., (1998) they stated that organic fertilizers are play a vital role in increasing wheat minerals composition compared with
inorganic ones. Confirm these results Arisha and Bradisi (1999) they found that organic fertilizers has a promotive effect on potato growth, yield and its quality and mineral composition under sandy soil conditions compared with inorganic ones.

3.5. Chemical constituents

The concentrations of total carbohydrates, total protein, vitamin “C” and vitamin “A” in chickpea seeds were appreciably influenced by Co treatment (Table 9). Application of Co at 8 ppm led to the maximum concentrations of total carbohydrates, total protein, vitamin “C” and vitamin “A”. These results are in harmony with those obtained by Gad (2012) revealed that Co addition in plant media increased total protein, total carbohydrates and total soluble sugars in groundnut seeds. Similar findings were reported by Korayem et al., (2014) in rice, Gad and El–Metwally (2015) in corn and El–Metwally and Gad (2019) in wheat.

As shown in Table 9 all of the organic fertilizers treatments significantly improved the concentrations of total protein, total carbohydrates, vitamin “C” and vitamin “A” in chickpea seeds. The largest values were obtained from the chicken manure treatment followed by farmyard manure and control (NPK) treatments.

Table 9: Effect of cobalt and organic fertilizers on chemical constituents in chickpea seeds (Mean of two seasons).

| Characters | Total proteins | Total carbohydrate % | Total soluble sugars | Vitamin (C) (mg/100g fw) | Vitamin (A) |
|------------|----------------|----------------------|---------------------|--------------------------|-------------|
| Cobalt:    |                |                      |                     |                          |             |
| With cobalt| 21.66          | 19.79                | 11.48               | 4.30                     | 2.57        |
| Without cobalt | 15.86       | 18.72                | 9.87                | 3.76                     | 2.00        |
| F. test    |                |                      |                     |                          |             |
| Control (NPK) | 18.78        | 19.18                | 10.43               | 3.90                     | 2.63        |
| Chicken manure | 22.91        | 21.57                | 12.05               | 4.69                     | 2.78        |
| Farmyard manure | 18.04       | 19.79                | 11.24               | 4.39                     | 2.49        |
| Cotton compost | 15.32        | 16.48                | 8.99                | 3.14                     | 2.02        |
| LSD at 5%  |                |                      |                     |                          |             |

The interaction effect of organic fertilizers treatments and Co significantly affected total protein, total carbohydrates, vitamin “C” and vitamin “A” as maximum values were obtained with combined treatment of chicken manure and 12 ppm Co (Table 10). The cotton compost plots without Co application gave the smallest total protein, total carbohydrates, vitamin “C” and vitamin “A”. Cobalt increased all chemical contents as a quality of chickpea seeds. These results are in harmony with those obtained by Nadia Gad and Nagwa Hassan (2013) they pointed that cobalt supplement with different organic fertilizers improves chemical contents of tomato fruits. Confirm these results Griffiths and Lunce (2001) they stated that, for human, high vitamin “C” dietary, intake correlates with reduced gastric cancer risk. Vitamin “A” is an antioxidant and its essential to human growth normal physiological functions, health of the skin as well as mucus membranes.

Table 10: Effect of the interactions between cobalt and organic fertilizers on total protein %, total carbohydrate%, vitamin C and vitamin A in chickpea seeds (Mean of two seasons).

| Characters | Total protein | Total carbohydrates | Vitamin C | Vitamin A |
|------------|--------------|---------------------|-----------|-----------|
|            | With cobalt  | Without cobalt      | With cobalt | Without cobalt | With cobalt | Without cobalt | With cobalt | Without cobalt |
| Control (NPK) | 20.25        | 17.31               | 20.00      | 18.36      | 3.98        | 3.82        | 2.23        | 1.51        |
| Chicken manure | 25.50        | 20.31               | 22.11      | 21.03      | 5.11        | 4.27        | 2.96        | 2.59        |
| Farmyard manure | 23.94        | 12.13               | 20.16      | 19.42      | 4.76        | 4.01        | 2.79        | 2.18        |
| Cotton compost | 16.94        | 13.7                | 16.88      | 16.07      | 3.34        | 2.93        | 2.30        | 1.73        |
| LSD at 5%   | 0.36         | 0.82                | 0.23       | 0.19       |             |             |             |             |
4. Conclusion

Cobalt is a promising element in the newly reclaimed soils. Organic fertilizers decreases soil pH and increase the availability of cobalt and micronutrients. Cobalt has a significant beneficial effect on chickpea growth, yield and seeds quality under organic fertilization.

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