

Effect Infection of Azotobacter Chroococcum, Azospirillum Brasilense, Poultry Residues in Ammonium Concentration and (Sorghum Bicolor L.)

Hussein Ahmed Abdul Ali¹, Jawad Abdul Kadhim Kamal¹

(College of Agriculture / University of Al-Qadisiyah / Iraq)

E-mail : Hussamusa5@gmail.com

jawad.alshabbany@qu.edu.iq

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Abstract: A field experiment was carried out in one of the fields located in Al Muthanna Governorate / Samawa district / Mohamed Ali region in sedimentary soil with Silt Clay in the autumn season of 2018 To study the effect of Azotobacter chroococcum, Azospirillum brasilense, poultry residue in ammonium concentration and growth of white maize(Plant height, dry matter weight, available soil content of ammonium) The experiment was designed using a three-replicated (R.C.B.D) experiment. Experimental factors included two levels of Azospirillum brasilense (infection and without infection) and two levels of Azotobacter chroococcum (infection and no infection) and three levels of poultry waste (0.3, 5)T.ha⁻¹ Respectively, and sorghum bicolor (L.) Moench was cultured on 23/7/2018. The results of the field experiment can be summarized as follows:

1. A baselines injection was given a significant increase in plant length, dry matter content and the soil content of ammonium concentration at the time of flowering Reaching 204.08 cm, 1.784 T.h⁻¹, 77.48 mg NH⁴ kg⁻¹ soil respectively compared to the control treatment.
2. A single bacterial infection with A. chroococcum gave a significant increase in all the above traits, reaching 204.59 cm, 1.785 T.ha⁻¹, 77.73 (mg NH⁴kg⁻¹ soil), respectively, compared with control treatment.
3. The level of 5 t .h - 1 of the poultry residues increased significantly in all the above qualities, reaching 206.93 cm and 1.88 T.ha-1 , 78.78 mg NH⁴kg⁻¹ soil, respectively, compared to control treatment.
4. Interval treatment (A.brasilense + 5 T.h⁻¹ poultry waste) significantly increased dry matter content and the soil content of ammonium during the period of flowering amounted to 2.00 t.h-1, 80.38 mg NH⁴ kg⁻¹ soil, respectively compared with the control treatment.
5. Treatment of interaction (A.chroococcum + 5 T. h⁻¹ Poultry residues) significant increase in the soil content of ammonium during the period of flowering amounted to 81.66 (mg NH⁴ Kg⁻¹ soil) compared to control treatment.
6. The treatment was of interaction duple (A.brasilense + A.chroococcum) gave a significant increase in the dry matter yield of 1.89 t.ha-1.
7. the treatment of the tripal interaction was given significant increase (A.brasilense + A.chroococcum + 5 t. h-1 Poultry residues)significant increase in all of the above characteristics Reaching 216.60 cm and 2.14 tons., 83.68 (mg NH⁴ kg⁻¹ soil), respectively, compared to the control treatment, Which gave a lower set.

Key words: A.brasilense , A.chroococcum , Poultry waste , Sorghum.

I. INTRODUCTION

Sorghum bicolor (L.) Moench is ranked fifth in the world after wheat, rice, maize and barley crops in terms of planted area and productivity [1]. It is grown either for the production of green fodder or grain or the work of silage, such as yellow maize, where the use of white corn grain as a food for humans, making some of the types of beer and also enter into the manufacture of bread, and used in animal feed by providing in the form of green feed or Driss or Papers [2].

Azotobacter and Azospirillum bacteria were the most active free nitrogen-fixing bacteria. Research has shown that 100 bacterial strains of nitrogen could be isolated from the rhizosphere, but Azotobacter and Azospirillum are the most efficient in stabilization [3]. Azotobacter and Azospirillum are non-specialized bacteria that can improve plant growth

through the release of certain hormones enzymes and vitamins, and stabilize atmospheric nitrogen in varying amounts, which positively effect on plant growth and increase productivity [4].

Organic waste from animal nutrition is an excellent source of organic matter because it contains all important nutrients. It is important for maintaining soil sustainability and productivity through its important role in improving its physical, chemical and biological properties. And plant evolution [5].

Nakao et al. [6] studied the effect of inoculation of sorghum plant with *Azospirillum brasilense* and found that pollination resulted in a significant increase in dry matter production and plant height by 18.4% and 134.7 cm, respectively. Foliar area and total dry matter when inoculating the white maize plant with *Azotobacter chroococcum*. Nitrogen uptake increased by 163.6%. Harran [7] observed a significant increase in the nitrogen content of white maize plant by 76% when inoculated with *A. brasilense*. Amujoyegbe et al. [8] obtained a significant increase in dry matter yield and leaf area when fertilizing white maize plant with poultry residues, reaching 68.1 g. Also, Agbede et al. [9] obtained a significant increase in plant height, leaf area and leaf nitrogen content when poultry residues were added to sorghum. Al-Ansari and Aliaie [10] studied the effect of using different types of organic residues on ammonium concentration in soil and found the superiority of poultry residues in giving the highest amount of ammonium 1698.02 mg NH₄ kg⁻¹ soil, as. [11] obtained an increase in plant height, leaf area and dry yield when inoculation with *Azotobacter* + *Azospirillum*, and Suhail et al. [12] studied the effect of double addition between *A.chroococcum* + poultry residues in corn plant. There was a significant increase in plant lengths and leafy area by 111.62% and 74.56%, respectively .

The study were summarized as follows:

- Effect of bacterial effect *Azotobacter chroococcum* and *Azospirillum brasilense* and poultry residues on ammonium concentration and growth and yield of sorghum plant.
- Effect of overlap between factors on ammonium concentration and growth and yield of sorghum plant.

II. Materials and Methods

A field experiment was carried out in clay soils to cultivate sorghum bicolor (L.) Moench local variety (Akifa) in one of the fields of a peasant in the area of Mohammed Ali orchards in Samawah district - the center of Muthanna province .

soil samples

Soil samples are analysis conducted in the laboratories of the College of Agriculture / University of Muthanna to study some physical and chemical Table (1).

Experimental design

The experiment was designed using a full randomized sector design (R.C.B.D) experiment using two levels of *Azotobacter chroococcum* (inoculation and noinoculion) and two levels of *Azospirillum brasilense* (inoculion and no vaccination) and the addition of three poultry residues (0, 3, 5) ha⁻¹ .

bacterial isolates (*Azospirillum* and *Azotobacter*) and poultry residues

The bacterial isolation of *Azospirillum* bacteria from the agricultural research department in Al-Zaafaraniya area of Baghdad governorate. The isolation of *azotobacter* bacteria was obtained from the college of agriculture - Al-Qadisiyah University, also obtained organic matter (poultry waste) from one of the poultry fields in the province of Muthanna.

Add compost (poultry waste)

poultry residues were added at the rate of (0, 3, 5) ton. h⁻¹ according to the experimental parameters, as 1200 g was added to the experimental unit containing the treatment 3 tons. h⁻¹, while 2000 g was added to the experimental unit containing the treatment 5 tons. h⁻¹ and without addition to the experimental unit containing the treatment zero ton. Some chemical properties of the studied poultry waste were analyzed Table (2).

Inoculation of seeds

The seeds were sterilized superficially using Hg₂cl₂ chloride and 95% ethyl alcohol according to [13] and then washed with sterile distilled water 4 times to remove any trace of chloride and then inoculated with white corn seeds by adding 10% of gum Arabic (prepared by dissolving 8 g in 100 ml water). Distilled into a pot containing seeds and left the seeds in it for 8 minutes and then dried pneumatically and placed in 300 ml of liquid farm for the bacteria *A.chroococcum* and left for a quarter of an hour as fogging section of the seeds inoculated *A.brasilense* bacteria and then planted directly.

Crop service operations

Crop service after planting included grafting, as well as the process of individualization, as well as weeding in the early stages of growth, as well as Use of granular diazinon 10% active feed to control leg insect (*Sesamia cretica* L.) by 800 g diazinon / acres and in the first two batches at the stage of flowering and the second after 15 days after the first addition, was also regular irrigation of the field. The fertilizer recommendation was added to use N46% ($(\text{NH}_2)_2\text{CO}$ fertilizer per treatment at a rate of 60 kg. ha⁻¹ was a source of nitrogen and DAP fertilizer (P46, N: 18 (DAP%)) was added after deducting nitrogen from it at a rate of 80 kg. As a source of phosphorus, 80 kg was added of K₂SO₄ (36%) of potassium sulphate fertilizer was used as a source of potassium. Phosphorus and Potassium was added in the form of two batches, the first in planting and the second after a month of germination [14]. While urea added in three batches [15].

At the end of the season the following plant measurements were made:

- Plant height (cm)
- Dry matter yield (ton. ha-1)
- The soil content of ammonium: Estimation of NH_4^+ -N Ammonium: Determination of ready ammonium in soil by extraction of potassium chloride solution (2 molar) and using magnesium oxide Mgo is distilled after evaporation of the microcoulidal device according to the method [16] contained in Page et al. [17].

statistical analysis

The mean parameters were compared using the least significant difference test (L.S.D) at a significant level of 0.05 using the calculator based on the statistical program (S.A.S) under the operating system (Windows 2010).

Table (1): Same characters physical and chemical to soil before planet.

unit	value	unit	value
pH (1:1)	7.52	Sant(gm.kg ⁻¹)	118
EC (1:1)	3.8	lomy(gm.kg ⁻¹)	479
Nitrogen availability Mg.kg ⁻¹ soil	18	clay(gm.kg ⁻¹)	403
phosphorus Mg.kg-1 soil	7.2	texture	Clay lomy
patasuum Mg.kg ⁻¹ soil	99	o.m%	0.2
C.E.C	25	Cinte mouk.kg ⁻¹ soil	25

Table (2): Same characters chemical to poultry residues for steady.

Adjective	unit	value
pH (1:4)	7.52
E.c(1:4)	ds.sm.m-1	7.1
Carbon Orgin	gm.kg-1	244.12
CN	8.78
Total nitrogen	gm.km-1	27.8
Total phosphorus	gm.km-1	16.2

III. Results and discussion

Effect of addition of *A. brasilense*, *A. chroococcum* and poultry residues on plant height (cm. plant)

The results of Table (3) showed that the single pollination of *A. chroococcum* resulted in a significant increase in plant height. The addition gave the highest height of 204.59 cm compared to the treatment of non-addition 182.69 cm. In addition to the production of plant hormones such as [18], these hormones encourage elongation of cells under the developing apex by their indirect effect on water entering the cell causing elongation. These results are consistent with [19].

Also, the results indicated that there was a significant increase in plant height as a result of the addition of the bacterial vaccine *A. brasilense*. Inoculation gave the highest plant height 204.08 cm compared to 182.69 cm with no inoculation treatment. Seed germination by improving the seed gut's ability to exploit soil food sources (such as nitrogen) and even available in limited quantities thus increasing plant height [20]. These results are consistent with the [14].

The results also showed a significant increase in plant height when fertilized with poultry residues (C) by achieving the level of addition 5 tons. h^{-1} . The highest height 206.93 cm compared with the treatment of control 182.69 cm as level 5 ton did not differ significantly from the level 3 ton. 202.05 cm While this level differed from the level of not adding 191.86 cm, this increase in height may be attributed to the high content of organic residues of elemental nitrogen, which has a key role in the building of amino acid tryptophan and reflected on the promotion of cell elongation and thus increased the height of the plant (press These results are consistent with what he found [21,22].

The results also indicated that the interaction of A + B (*A. chroococcum* + *A. brasilense*) did not significantly affect the mean height, generally the highest value was 208.47 cm and the lowest value was 182.69 cm for the control treatment.

The results showed that the two C + A (*A. chroococcum* + poultry residues) did not significantly increase the height.. It is noticed from the table that the bilateral interaction C + B (*A. brasilense* + poultry residues) did not significantly affect the height of the plant. The reason for this may be due to the high residue content of the element nitrogen uric acid, which inhibited the effectiveness of the bacterium *Azospirillum* and *Azotobacter* in nitrogen availability important in the formation of proteins important in the elongation of plant cells.

The results of the table confirmed that the triple interaction A + B + C (*A. brasilense* + *A. chroococcum* + poultry residues) resulted in a significant increase in plant height by giving treatment addition (*A. brasilense* + *A. chroococcum* + 5 tons. ha^{-1} poultry residue). The highest height of 216.60 cm compared to the control treatment 182.69 cm.

Table (3) :Effect of Addition of *A. brasilense*, *A. chroococcum* and Poultry Residues on Plant Height (cm.¹ Plant)

<i>A.chroococcum</i> (A)	<i>A.brasilense</i> (B)	Leveles poultry residue (C) Ton.h ⁻¹			Mine (A+B)	Mine (A)
		0	3	5		
Without add	Non inoculation	182.69	196.39	197.69	192.26	Without add 195.97
	inoculation	194.37	198.72	205.95	199.68	
Mine (C+A) Without add		188.53	197.56	201.82		add 204.59
add	Non inoculation	194.85	199.80	207.49	200.71	
	inoculation	195.55	213.27	216.60	208.47	
Mine (C+A) add		195.20	206.53	212.04		Mine (B)
Mine (C+B) Non inoculation		188.77	198.10	202.59		Non inoculation

Mine (C+B) inoculation	194.96	205.99	211.28	196.48
Mine (C)	191.86	202.02	206.93	
L.S.D _{0.05} to factor (A) 6.18	L.S.D _{0.05} to Factor B 6.18		L.S.D _{0.05} to Factor C 7.57	Inoculation 204.08
L.S.D _{0.05} to intraction batwen tow factor B*A N.S	L.S.D _{0.05} to intraction batwen tow factor C*A N.S		L.S.D _{0.05} to intraction batwen tow factor C*b N.S	
L.S.D _{0.05} to intraction batwen Factors A*B*C 15.14				

Effect of addition of *A. brasilense*, *A. chroococcum* and poultry residues on dry matter yield (ton. h⁻¹)

The results of Table (4) showed that the single inoculation of *A. chroococcum* bacteria resulted in a significant increase in dry matter yield 1.785 ton. h⁻¹ compared with no-added treatment 1.24 tons. h⁻¹, this increase may be attributed to the availability of *A. chroococcum* by atmospheric nitrogen, which is reflected in the increase of leaves, branches, flowers, fruits and roots, thus increasing the accumulation of dry matter of the plant [23], This result is consistent with [24].

It is noticed from the table that the single inoculation of *A. brasilense* bacteria resulted in a significant increase in dry matter yield. The highest yield was 1.784 tons. h⁻¹ compared to un inoculation plants 1.24 ton. This is due to the important role of *Azospirillum* bacteria in the availability of atmospheric nitrogen, which led to an increase in plant percentage (Rennie, 1980). This leads to an increase in the total vegetative and biological [6,25].

Also the table shows that fertilizing plants with poultry residues (C) resulted in a significant increase in the average yield of dry matter. It achieved the level of addition 5 tons.h⁻¹ highest average 1.88 tons.h⁻¹ compared to the control treatment of 1.24 tons. h⁻¹ also exceeded the treatment 5 tons. h⁻¹ significantly on the treatment 3 tons. h⁻¹.70 tons. h⁻¹ which significantly differed from the level of non-fertilization control 1.44 tons. h⁻¹. The reason for this increase is due to the positive effects of organic residues added in the processing of nutrients and increased absorption by the plant as well as improve the properties of the soil and increase its ability to retain water and nutrients and increase the growth of roots and absorption of nutrients [26].

Also, the interaction between *Azospirillum* and *Azotobacter* bacteria (A+B) had a significant effect on the dry matter yield of the plant 1.89 t.ha⁻¹ and significantly increased compared to the treatment of control 1.24 ton. The reason for the increase may be attributed to the positive effects of azotobacter and azospirillum bacteria in stimulating plant growth by supplying it with nitrogen and growth regulators. This result is consistent with [27].

The results also indicated a non - significant increase in dry matter yield as a result of bilateral C + A (*A. chroococcum* + poultry residues), may be due to the high content of residues of the element nitrogen, which inhibited the effectiveness of the bacterium *Azospirillum* in availability atmospheric nitrogen is important in increasing the growth of vegetative parts of the plant, which leads to the increase of dry matter.

Also, the interaction between *Azospirillum* bacteria and poultry residues C + B (*A. brasilense* + poultry residues) had a significant effect on the dry matter yield of the plant, where the interaction treatment (*A. brasilense* + 5 tons. E⁻¹ poultry residue) gave the highest dry yield. 2.00 Ton. h⁻¹ and significantly increased compared to the treatment of control 1.24 ton. The reason for the increase achieved by bilateral interaction C + B may be attributed to the decomposition of poultry waste added by bacteria *A. brasilense* through the use of these wastes as a source of carbon and energy and this led to the increase of bacterial activity is important in increasing the availability of nitrogen and excretion of oxins and reflected in the increased growth of parts Vegetative and root and thus increase the dry yield.

The effect of triple interaction A + B + C (*A. brasilense* + *A. chroococcum* + poultry residues) in the yield, the results indicated the addition treatment (*A. brasilense* + *A. chroococcum*) and 5 ton. ha⁻¹ poultry residues higher dry

matter yield 2.14 tons h^{-1} and significantly increased compared to the treatment of comparison, which gave the lowest value of 1.24 ton. h^{-1} .

Table (4): Effect of addition of *A. brasilense*, *A. chroococcum* and poultry residues on dry matter yield (ton. h^{-1})

<i>A.chroococcum</i> (A)	<i>A.brasilense</i> (B)	Leveles poulatry residue (C) Ton.h ⁻¹			Mine (A+B)	Mine (A)
		0	3	5		
Without add	Non inoculation	1.24	1.53	1.61	1.46	With out add 1.567
	inoculation	1.48	1.66	1.86	1.67	
Mine (C+A) Without add		1.36	1.59	1.74		add 1.785
add	Non inoculation	1.46	1.64	1.90	1.67	
	inoculation	1.58	1.96	2.14	1.89	
Mine (C+A) add		1.52	1.80	2.02		
Mine (C+B) Non inoculation		1.35	1.59	1.76		Non inoculation 1.568
Mine (C+B) inoculation		1.53	1.81	2.00		
Mine (C)		1.44	1.70	1.88		Inoculation 1.784
L.S.D _{0.05} to facter (A) 0.11		L.S.D _{0.05} to Factor B 0.11		L.S.D _{0.05} to Factor C 0.14		
L.S.D _{0.05} to intraction batwen tow factor B*A 0.24		L.S.D _{0.05} to intraction batwen tow factor C*A N.S		L.S.D _{0.05} to intraction batwen tow facter C*B 0.238		
L.S.D _{0.05} to intraction batwen Factors A*B*C 0.28						

Effect of addition of *A. brasilense*, *A. chroococcum* and poultry residues on ammonia-ready soil content (mg NH_4 . kg^{-1} soils)

Tables (5) show that single inoculation with *A. chroococcum* resulted in a significant increase in soil ammonium content, with the highest content of 77.73 mg NH_4 kg^{-1} soil compared with control treatment 63.83 mg NH_4^+ kg soil. This increase may be attributed to the nitrogen fixation of *Azotobacter* for use as a building source, which increased the soil ammonium content. Collins [28] noted that ammonium depends on the activity of soil microorganisms. This result is consistent with the results of [29], but in flowering the intraction was not significant.

The results showed that single inoculation with *A. brasilense* showed a significant effect on soil ammonium content in flowering. The inoculation gave the highest value of 77.48 mg NH_4 kg^{-1} soil and significantly increased compared to control treatment 63.83 mg NH_4^+ kg soil. It may be attributed to the ability of *A. brasilense* bacteria to availably atmospheric nitrogen, which used it as a source of building and reproduction, which led to an increase in its important numbers in increasing the process of representation and thus increase the soil content of ammonium after the death of cells of these bacteria.

The results of the addition of poultry waste (C) indicated that the level of addition 5 tons.h⁻¹ gave the highest content of 78.78 mg NH₄⁺ and significantly increased compared to control treatment 63.83 mg NH₄ kg⁻¹ soil . There was a significant difference between the level of 3 ton (177.53 mg NH₄ kg⁻¹ soil), while these levels (3 and 5 ton⁻¹) were significantly different from the level of no addition (0 ton) 69.23 mg NH₄ kg⁻¹ soil. The reason for this increase achieved by the addition of poultry residues is attributable to the acceptable percentage of C / N (Table .2) that affected the representation Nitrogen as well as the high nitrogen content of poultry residues in addition to the high readiness of this nitrogen in the residues [10] means that the acceptable percentage of C / N made the nitrogen present in the residues ready for mineralization. This finding is consistent with what he found [30]. The results confirmed that the bilateral interaction A + B (A. chroococcum + A. brasilense) did not lead to a significant increase in soil content of ammonium and for the two growth periods.

The results of the bilateral interaction C + A (A. chroococcum + poultry residues) indicated an increase in soil content of ammonium, where the treatment of addition (A.chroococcum + 5 tons. h⁻¹ poultry residue) gave the highest rate of content 81.66 mg NH₄. Kg⁻¹ soil compared with control treatment 63.83 mg NH₄. the reason for the increase achieved by the C + A binary interference may be attributed to the benefit of Azotobacter bacteria from the added poultry residues (Table 2) to be used as a source of carbon and construction, which led to an increase in their important numbers in increasing nitrogen fixation ,this is consistent with [31] ,who noted that when nitrogen becomes more available in the soil, the organisms become less consumed and begin to mineralize convert it to ammonium).

It is also observed from the two tables that the bilateral interaction between A. brasilense and poultry residues C + B led to a significant increase in soil content of ammonium, where the fertilized treatment gave (A.brasilense + 5 tons. Soil content of ready ammonium 80.38 mg NH₄ kg⁻¹ soil compared to the treatment of control 63.83 mg NH₄ kg⁻¹ soil, the reason for the increase achieved by the (C + B) is due to the fact that poultry residues contain a good ratio of carbon to nitrogen C / N (less than 22) which made organisms (such as A. brasilense) do not consume the nitrogen present in the waste to build their cells, but also increased the nitrogen representation in the soil and thus increased the soil mineral content (such as ammonium) [32]. At the end of the season, the interaction between Azospirillum and residues was insignificant.

The results also indicated that the triple interaction between bacterial inoculation and poultry residues significantly affected the soil content of ammonium , the interaction treatment (A.brasilense + A.chroococcum) and 5 tons. h⁻¹residues with the highest value of 83.68 mg NH₄ kg⁻¹ soil and significantly increased compared to control treatment 63.83 mg NH₄ kg⁻¹ soil .

The reason for the decrease in the amount of ammonium in the soil at the end of the season compared to the flowering period may be due to the stabilization of nitrogen in clay minerals or organic matter and consumption of the other part by the plant and reflected on the small amount of ammonium at the end of the season and this result is consistent with the results [10].

Table (5) : Effect of addition of A. brasilense, A. chroococcum and poultry residues on soil ammonium content at flowering period (mg NH₄ kg⁻¹ soil).

<i>A.chroococcum</i> (A)	A.brasilense (B)	Leveles poulatry residue (C) Ton.h ⁻¹			Mine (A+B)	Mine (A)
		0	3	5		
Without add	Non inoculation	63.83	74.55	75.27	71.21	Without add 72.62
	inoculation	69.96	75.60	67.55	74.03	
Mine (C+A) With out add		66.90	75.07	75.91		add 77.73
add	Non inoculation	68.23	76.30	79.10	74.54	
	inoculation	48.22	74.90	83.68	80.93	
Mine (C+A) add		71.56	79.99	81.66		Mine (B)

Mine (C+B) Non inoculation	66.03	75.42	77.18	Non inoculation 72.88
Mine (C+B) inoculation	72.43	79.64	80.38	
Mine (C)	69.23	77.53	78.78	
L.S.D _{0.05} to factor (A) N.S	L.S.D _{0.05} to Factor B 2.87		L.S.D _{0.05} to Factor C 3.52	Inoculation 77.48
L.S.D _{0.05} to intraction batwen tow factor B*A N.S	L.S.D _{0.05} to intraction batwen tow factor C*A 5.61		L.S.D _{0.05} to intraction batwen tow factor C*b 5.74	
L.S.D _{0.05} to intraction batwen Factors A*B*C 7.05				

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