Bionatura
Latin American Journal of Biotechnology and Life Sciences

Bionatura Issue 1 Vol 8 No 1 2023

Article

Effect Of Bacteria And Yeast Bio Fertilization On Nitrogen Budget, Growth, And Yieid Of Wheat (*Triticum Aestivum* L.) When Intercropping With Faba Bean (*Vicia Faba* L.)

Hussein Ahmed Mohammed[1]* and Kareem Ubaid Hasan[2]
[1]Department of Soil Sciences and Water Resources, Iraq.
[2]Department of Soil Sciences and Water Resources, College of Agricultural Engineering Sciences, University of Baghdad, Iraq.
*Correspondence: Hussein.ahmed1107a@coagri.uobaghdad.edu.iq
Available from: http://dx.doi.org/10.21931/RB/CSS/2023.08.01.79

ABSTRACT: The study was conducted in the College of Agricultural Engineering Sciences - University of Baghdad on soil with a mixture of loam during the winter season of the year (2020-2021). The study included a field experiment to evaluate the effect of the prepared nitrogenous bacterial biofertilizer and yeast extract at a concentration of 5 $g.L^{-1}$ and mineral fertilization on the nitrogen budget in the soil and in the growth parameters of wheat plants and the interaction under the 50% level of the fertilizer recommendation with the use of a recommendation treatment Complete fertilizer 100% For comparison, the amount of water added to each experimental unit was measured after draining 50% of the prepared water using a water meter. A (factorial) experiment was carried out by arranging the split plates (The Split-Plot Design) according to the (RCBD) design. The results of the experiment showed the moral superiority of the intercropping coefficients in Dry weight, the yield of grain weight, and nitrogen concentration in the soil and plants for biological fertilization treatment, where bacterial fertilization and yeast recorded the highest values compared with the mineral fertilization 50 and 100% If it gives an average of (6.667 and 11.533) ($Mg.ha^{-1}$) for dry weight and grain yield, respectively, and 39,730 $mg.Kg^{-1}$ nitrogen concentration in the soil and 1.367 % nitrogen concentration in the plant compared to the dry weight (4.567 and 4.633) ($Mg.ha^{-1}$), grain yield (10,066 and 8,300) ($Mg.ha^{-1}$), and the nitrogen concentration in the soil (24,400 and 22,200) $mg.Kg^{-1}$ and nitrogen concentration in the plant (1.237 and 1.043), respectively, for 50 and 100%. The mineral fertilization treatments of 100% also recorded the highest value of ammonia volatilization, amounting to 19,700, followed by 50% treatment at 17.746, and the lowest amount of volatile ammonia was recorded by the bacterial fertilization treatment at 12.976, then the treatment of 12.976 Bacteria with yeast extract 16.980 and yeast treatment 17.960 (kg N ha^{-1})for the intercropping treatments.

Keywords: Bio fertilization, Yeast extract, Mineral fertilization, Budget nitrogen intercropping
It is partially extracted from the Ph.D. thesis of the first researcher.

Introduction

Wheat, a staple cereal crop contributing about 20% of calories to the diet and at least 30% of iron and zinc worldwide, contains the highest micronutrients among

the three significant grains: wheat, rice, and maize. [1] Wheat contains 25% protein and calories. The produced spell is used to make bread, as its kernels contain all the essential nutrients from carbohydrates 60–80%, proteins 8–15% amounts of essential amino acids, 1.5–2.0% fats, and 12% water, [2,3] indicated that the use of PGPR for farmers could reduce the use of artificial fertilizers and increase the sustainability of wheat crop production. The selected strains were tested in three experiments (using a growth chamber, pot and field experiment). Saccharomyces cerevisiae is of economic importance because of its enormous enzymatic capabilities of Zymas, which breaks down sugar molecules and converts them to pyruvic acid, to acetaldehyde, then turns to CO_2 and ethyl alcohol, and CO_2 is fixed in the Calvin cycle. It also contains vitamins, including B_1, B_2, B_3, B_5, B_6, B_7, B_9, and B_{12}[4, 5, 6, 7],8, indicating that there was a significant difference in the growth characteristics of wheat plants fed on yeast extract, including (plant height, number of branches, leaf area, dry weight of leaves, dry weight of branches and dry weight of the spike). [9] indicated that there is a significant difference in the characteristics of wheat yield and its components as a result of adding yeast extract at a concentration of 200 kg feddan^{-1} (476.19 kg.ha^{-1}), which are (number of spikes, dry weight of the spike, grain yield, straw yield, and biological yield) with averages of 571.08 spike m^{-2} and 698.59 g.m^{-2} and 4.52 Mg.ha^{-1},13.76 Mg.ha^{-1}and 18.28 Mg.ha^{-1} for the traits, respectively, and no significant difference was observed for the two traits, the weight of one thousand grains and the harvest index. [10] indicated the investigation of the effects of intercropping agriculture and foliar spraying with yeast on pea plants' growth and yield traits. The results showed that the highest values were noticed for the treatment JY5 for leaves number 26.87 leaf.plant^{-1}, pod number 24.03 pod.plant^{-1} and plant yield 177.00 g.plant^{-1} and the treatment AY5 referred to decrease days number until 50% of flowering to 110.10, pod weight 7.57 g.pod^{-1}, seed number per pod 7.13 seed.pod^{-1} and percentage of protein 24.80%. In contrast, treatments of intercropping The results showed that The spraying of yeast extract at 5 mg.L^{-1} led to positive and significant effects and increased the competition in peas in the intercropping system. The results of a field experiment conducted by [11] The between bio fertilization and organic extracts indicated a significant effect, where the interaction between amino acids and bio health significantly excelled on the traits plant height 57.60 cm², leaf area 1682 cm², percentage of potassium 2.515%, nitrogen in the curds 5.93%, percentage of nitrogen in the leaves 5.39%), and the percentage of protein (7.41%). A field experiment conducted by [12] during the 2016-2017 and 2017-2018 seasons, the experiment included two factors, the first being the cultivation of three wheat cultivars (Bohouth 22, Abaa 99, Abu Ghraib 3) and the second factor foliar spraying of yeast powder at a concentration (1000,2000). Mg L^{-1} and the ground addition of yeast powder at a concentration of (4000,8000) mg.L^{-1} and the control treatment. The spraying treatments were added to both experiments in two phases, the first when the stem had three leaves and the second when the plant entered the flowering stage. The cultivars Bohouth 22 significantly outperformed the studied growth characteristics. Root total recipes were represented by the length of the root total, dry weight, grain yield with an average of 5.49 and 5.26 Mg.ha^{-1}, and the number of spikes with an average of (457.47 and 473.87. m^{-2}, and the weight of one thousand grains with an average of (31.18 and 32.92) g for both seasons. Intercropping is a land management practice in an agricultural environment where at least two types of crops are grown in the same field at the same time [13]. Intercropping is one of the systems of agricultural intensification that can improve productivity and reduce water use and greenhouse gas emissions. [14] As shade increases through intercropped cultivation, a field can reduce soil moisture

evaporation and improve water and nutrient use efficiency by dividing resources among different crops. In a field experiment, [15] mentioned that the interaction of wheat and beans significantly increased the productivity of grains by 11.4% and 34.2% compared with the monocropped crops. The biomass of the interaction with wheat increased strongly and more positively than the beans, as the biomass was 1.15 and 1. 21. This means that the intercropping of wheat/beans led to an overall improvement in the performance of both crops.

Research aims:

1. Producing biofertilization (Azospirillum lipoferum and Bacillus megaterium) isolated from some soils.

2. Studying the effect of bio fertilization and yeast extract and their interaction in the intercropping of wheat and beans and their interaction.

3. Studying the effect of bio fertilization, yeast extract, and mineral fertilizer on nitrogen budget.

Materials and Methods

Experiment location

A field experiment was conducted at the College of Agricultural Engineering Sciences - the University of Baghdad in the field of the Department of Soil and Resources, in which the main factor was the wheat plant, the intercropping of wheat with the bean, and the second factor a bacteria (Azospirillum lipoferum) with two levels and the other secondary factor was yeast with two levels and three replicates for all factors and according to the following order:

Without bio-fertilizer with 50% mineral fertilizer from the fertilizer recommendation and symbolized by (T1), 100% mineral fertilization, symbolized by (T2), Azospirillum lipoferum with 50% mineral fertilizer and symbolized by (T3), The secondary factor is yeast extract. It consists of two levels: yeast extract added in liquid form (spray) 5 $g.L^{-1}$ with 50% mineral fertilizer symbolized by it (T4), Azospirillum lipoferum with yeast with 50% mineral fertilizer and symbolized by (T5). The place of the experiment was prepared. The land was plowed perpendicularly, and the process of leveling and smoothing was conducted for it. The field was divided into experimental units. The area of each experimental unit was 2 x 2 m, and an area of 4 m^2 was included. Each experimental unit had 4 lines for wheat, leaving a distance between one line and another 0.4 m and 0.5 m between the experimental units and 1 m between the replications. Wheat slabs were planted in a line. As for the intercropping panels, they were planted with 5 lines (beans, wheat, and beans) and left 0.1 m between one line and another. The transactions were distributed. The seeds were randomly planted on 11/15/2020. Soil moisture was maintained for the experimental units when 50% of the prepared water was drained after estimating the moisture based on the weighted Method to maintain an optimum moisture percentage for the activity of the microorganisms used in the experiment. He got rid of the bush growing in the field, competing for the plant. The wheat used was from the Bohouth 22 variety, and the beans were from the local variety. The biological pollen was cultivated and added in the early morning.

Fertilization

Half of the fertilizer recommendation for wheat was approved, which is 100 kg N ha^{-1}urea fertilizer (N 46%), 50 kgPha^{-1}triple superphosphate fertilizer (21% P),

and 30 kg K ha^{-1}potassium sulfate fertilizer (43% K). The bean plant has adopted half of the fertilizer recommendation, which is 50kgNha^{-1}urea fertilizer (N46%), 50 kg P ha^{-1}triple superphosphate fertilizer (21% P), and 20 kg K ha^{-1}potassium sulfate fertilizer (43% K). The form of batches, nitrogen fertilizer and potassium fertilizer was added in two batches when planting and after 45 days, while phosphate fertilizer was added in one batch when planting, and the full fertilizer recommendation of 100% (as a comparison treatment) was used for wheat, beans and intercropping [16].

Isolation of Azospirillum lipoferum bacteria from Rhizosphere soil

A.lipoferum was isolated from soil samples using soil culture media (Nfb) according to the method [17]

Yeast preparation

Saccharomyces cerevisiae yeast solution was sprayed. After its preparation and at the specified concentration, 5 g per liter of sterile distilled water and sugar to it in a ratio of 1:1 and leaving in a warm place for a whole night and spraying during the morning period, each according to its treatment and in three batches when the plant has entire leaves after a month of germination, and it was between one spray and another 15 ten days [18].

The dry weight of wheat gm plant^{-1}

According to the dry weight of the wheat, plant based on an area of 0.3 m2 for each experimental unit a week before the flowering stage, the samples were placed in perforated bags prepared for this purpose and entered into an electric oven at (65) °C (48) hours, then their weights were recorded after being measured with a sensitive scale and transferred to (Mg ha^{-1})

Dry weight Beans (gm)

Five plants were randomly harvested from the middle of the overlap panels, air-dried, and then dried in an electric oven at 65 °C to constant weight, as mentioned in [19], according to the average weight of the five plants.

The total yield of green pods gm plant^{-1}

The average yield of five plants was calculated starting from 20-2-2021 until 1-4-2021, and in aggregate form, and from it, the bean yield in hectares was calculated. As for the yield of wheat grains after harvesting the middle line, with an area of 0.8 m^2 (1 line x 0.4 m x 2 m length), studied and weighed Grains then converted into yield (Mg.ha^{-1})

Plant analysis

After the samples were dried at 65°C for 48 hours, they were then weighed, then the samples were ground and mixed well to homogenize and take (0.2) gm. [20]

Amount N absorber

The amount of nitrogen absorbed in the plant was estimated according to the following equation

Nutrient absorption = dry weight * elemental concentration %

Volatile ammonia ↑ NH3:

Ammonia volatilization in the field was measured using a method modified from the laboratory [21]. Nitrogen test indicators (Boric acid, Methyl red, and Bromocresol green) were put in a baker to capture ammonia and for analysis. These bakers were driven (placed) in different places in the field and covered by suitable cover. After proper time, ammonia was collected and taken to the laboratory for determination. Ammonia volatilized was calculated according to the following formula

NH3 –N volatilize =Volume of consumed acid x N x14x100/ amount of nitrogen Applied x1000

N	Properties	Amount	Unit
1	pH	7.21	
2	EC(1:1)	2.55	$dS.m^{-1}$
3	Available (NH_4^++NO_3^-)	21.10	$mg.kg^{-1}$ soil
4	Available P	11.50	
5	Available K	140.43	
6	Ca^{+2}	9.33	$mmol.L^{-1}$
7	Mg^{+2}	6.88	
8	Na^+	5.22	
9	K^+	0.35	
10	HCO_3^-	3.28	
11	SO_4^{2-}	8.42	
12	Cl^-	13.10	
13	CO_3^{-2}	Nil	
14	CEC	18.22	$Cmol+kg^{-1}$ soil
15	SOM	5.33	$gm.kg^{-1}$soil
16	Texture	Loam	
19	Total bacteria	10^6 18 ×	$Cfu.g^{-1}$ dry soil
20	Total Fungi	$\times 10^4$ 3.5	

Table 1: Soil chemical, physical and biological properties of the soil before planting.

Results

The dry weight of wheat (Mg ha^{-1})

The results are shown in Table 2, which shows the effect of biological fertilization, yeast, and mineral fertilization on the dry weight of single wheat

plants and wheat intertwined with the bean plant. With an average of 4.917 Mg.ha^{-1}, the T4 treatment had an average of 4.579 Mg.ha^{-1} compared to the T1 and T2 treatments, which recorded an average of 3.950 and 4.213 Mg.ha^{-1}, respectively. The results showed that there were highly significant differences between the averages of the intercropped wheat plant with the bean plant and the sieved wheat plant, as the intercropped treatment recorded a rate of 5.453 Mg.ha^{-1}compared with the rate of single planting of 3.713 Mg.ha^{-1}. The results of the bilateral interaction between the bio fertilization and the interaction between the type of cultivation showed significant differences, as the bio fertilization treatments achieved a significant increase in the dry weight of wheat when intercropping with wheat monoculture. In contrast, the T5 treatment gave an average of 6.667 mg. compared to the treatment of T1 and T2, which recorded an average of 4.567 And 4.633, respectively, in intercropping, compared to T1 and T2 treatment, which recorded rates of 3.333 and 3.793 Mg.ha^{-1}, respectively, in monoculture of wheat.

Treatment	Wheat	Intercropping	Mean
T1	3.333	4.567	3.950
T2	3.793	4.633	4.213
T3	3.833	6.000	4.917
T4	3.757	5.400	4.579
T5	3.850	6.667	5.259
Lsd5%	0.703*		0.497**
Average Transactions	3.713	5.453	
Lsd5%	0.575**		

Table 2: Effects of different combinations of fertilizers and yeast extract on Dry weight of wheat (Mg.ha^{-1}).

Wheat yield of wheat (Mg ha^{-1})

The results were shown in Table 3, which shows the effect of biological fertilization, yeast and mineral fertilization on wheat yield (grain yield) of monoculture wheat and wheat intercropping with the bean plant was followed by T5 treatment with an average of 9.587 Mg.ha^{-1}, then T3 treatment with an average of 9.117 Mg.ha^{-1}compared to T1 and T2 treatment, which recorded an average of 8.725 and 7.154 Mg.ha^{-1}, respectively The results showed that there were highly significant differences between the averages of the intercropped wheat plant with the bean plant and the planting of the monoculture wheat plant, as the intercropped treatment recorded a rate of 10,198 Mg.ha^{-1}compared with the rate of monoculture planting 7.576 Mg.ha^{-1}The results of the bilateral interaction between the biological fertilization and the interaction between the type of cultivation showed significant differences, as the biological fertilization treatments achieved a significant increase in wheat yield when intercropping with monoculture cultivation, as the T5 treatment gave a rate of 11,533 Mg.ha^{-1}compared to the treatment of T1 and T2, which recorded a rate of 10.066 and 8,300, respectively, in intercropping and compared to T1 and T2 treatment,

which recorded an average of 7.383 and 6.008 Mg.ha^{-1}, respectively, in monoculture wheat cultivation.

Table 3: Effects of different combinations of fertilizers and yeast extract on yield of wheat (cereals) (Mg.ha^{-1}).

Treatment	Wheat	intercropping	Mean
T1	7.383	10.066	8.725
T2	6.008	8.300	7.154
T3	7.875	10.358	9.117
T4	8.975	10.737	9.856
T5	7.641	11.533	9.587
Lsd5%	0.402**		0.284**
Average Transactions	7.576	10.198	
Lsd5%	0.481**		

Table 3: Effects of different combinations of fertilizers and yeast extract on yield of wheat (cereals) (Mg.ha^{-1}).

The concentration of supply nitrogen in the soil is mg.Kg^{-1} in the harvest phase of wheat

The results are shown in Table 4, which shows the effect of biological fertilization, yeast, and mineral fertilization on the concentration of supply nitrogen in the soil a week before harvesting the monoculture wheat plant and the wheat intertwined with the bean plant. Amount of 33.835 mg. kg^{-1} followed by T3 treatment with an average of 27.635 mg. kg^{-1} then T4 treatment with an average of 23.375 mg.kg^{-1} compared to T1 and T2, which recorded an average of 21.835 and 19.675 mg.kg^{-1} sequentially The results showed that there were highly significant differences between the averages of the intercropped wheat plant with the bean plant and the monoculture wheat plant cultivation, as the intercropping treatment recorded an average nitrogen concentration of 29.026 mg.kg^{-1} compared to the average nitrogen concentration in the soil at monoculture planting of 21.506 mg.kg^{-1} The results of the binary interaction between the bio fertilization and the interaction between the type of cultivation showed highly significant differences, as the bio fertilization treatments achieved a highly significant increase in nitrogen concentration at the harvest stage in the intercropping cultivation compared with the cultivation of monoculture wheat, as the T5 treatment gave an average of 39.730 mg.kg^{-1} compared to T1 and T2, which recorded averages of 24,400 and 22,200 mg.kg^{-1} sequentially in intercropping and compared to T1 and T2 treatment, which recorded averages of 19.270 and 17.130 mg. kg^{-1} successively in single cultivation of wheat.

Treatment	Wheat	Intercropping	Mean
T1	19.270	24.400	21.835
T2	17.130	22.200	19.675

T3	22.070	33.200	27.635
T4	21.130	25.600	23.375
T5	27.930	39.730	33.835
Lsd5%	3.407**		2.409**
Average Transactions	21.506	29.026	
Lsd5%	0.182**		

Table 4: Effects of different combinations of fertilizers and yeast extract. The concentration of available nitrogen in the soil is mg.Kg^{-1} in the harvest phase of the wheat plant.

Total Nitrogen Concentration (%) Harvest Stage Wheat

The results are shown in Table 5, which shows the effect of bio fertilization, yeast, and mineral fertilization on the total nitrogen concentration in the plant during the harvesting phase of the monoculture wheat plant and wheat intertwined with the bean plant. kg^{-1} followed by T3 treatment with an average of 1.330 mg.kg^{-1} then T4 treatment with an average of 1.203 mg.kg-^{1} compared to T1 and T2, which recorded an average of 1.142 and 1.035 mg. kg $^{-1}$ sequentially

The results showed that there were significant differences between the averages of the intercropped wheat plant with the bean cultivar and that of the monoculture wheat plant, as the intercropping treatment recorded the average total nitrogen concentration in the plant amounted to 1.289 mg.kg^{-1} compared to the average total nitrogen concentration in the plant at a single planting of 0.955 mg.kg^{-1} The results of the bilateral interaction between the bio fertilization and the interaction between the type of cultivation showed highly significant differences, as the bio fertilization treatments achieved a highly significant increase in the total nitrogen concentration at the harvest stage in the intercropping cultivation compared with the cultivation of monoculture wheat, as the T4 treatment gave an average of 1.433 mg.kg^{-1} compared to treatment T1 and T2, which recorded averages of 1.237 and 1.043 mg.kg^{-1} sequentially in intercropping and compared to T1 and T2 treatment, which recorded averages of 1.047 and 1.027 mg.kg^{-1} successively in single cultivation of wheat.

Treatment	Wheat	Intercropping	Mean
T1	1.047	1.237	1.142
T2	1.027	1.043	1.035
T3	1.293	1.367	1.330
T4	0.973	1.433	1.203
T5	1.313	1.367	1.340
Lsd5%	0.147**		0.104**
Average Transactions	0.955	1.289	
Lsd5%	0.109*		

Table 5*:* The total nitrogen concentration in the plant (%) Harvest stage of the wheat plant.

Amount of nitrogen lost by volatility N-NH_3 (kg NH^{-1}) from wheat plant soil

The results of Table 6 showed that the addition of bio-fertilizer led to highly significant differences in the averages of bio-fertilization treatments in the amount of ammonia lost by volatility, as the T3 treatment, which gave the lowest amount of ammonia lost by volatility, was superior to 14.206 $kgNha^{-1}$, followed by the T5 treatment, which gave the amount of lost ammonia amounted to 16,310 $kgNha^{-1}$, followed by the T4 treatment, which gave the amount of lost ammonia amounted to 17,532 $kgNha^{-1}$. All the bio-fertilization treatments were superior in reducing the average volatile ammonia levels. It was superior to the control treatment of the mineral fertilization at 50%, which amounted to 19,125 kg N ha^{-1}, and the mineral fertilization at 100%, which gave the average volatilization amount, was 20,850 $kgNha^{-1}$. The results also showed that there were significant differences between the average cultivation of single wheat or wheat intertwined with the bean, as the interaction treatment excelled with the lowest average volatile ammonia amount, which amounted to 17,067 $kgNha^{-1}$, compared with the cultivation of monoculture wheat, which achieved 18.140 $kgNha^{-1}$showed The results of the two-way interaction between biological fertilization and the interaction between the type of cultivation were highly significant, as the fertilization treatments achieved Vital and significant increase in reducing the amount of volatile ammonia in wheat intertwined with beans compared with single wheat cultivation, as the T3 treatment gave the lowest amount of volatile ammonia in the intercropped wheat cultivation amounted to 12,976 kg N ha^{-1}compared to treatment T1 and T2, which recorded a rate of 17.746 and 19,700 kg N ha^{-1}, respectively in The intercropping was compared to the T1 and T2 treatment, which recorded an average of 20,505 and 22,000 $kgNha^{-1}$, respectively, in the monoculture of wheat.

The decrease in the amount of ammonia lost by volatilization is attributed to the biofertilization treatment, as attributed to the role of biofertilizer, as inoculation with Azospirillum bacteria leads to an increase in the surface area of the root system of the host plant so that it can prospect for soil and water minerals.

Treatment	Wheat	Intercropping	Mean
T1	20.505	17.746	19.125
T2	22.000	19.700	20.850
T3	15.436	12.976	14.206
T4	17.118	17.946	17.532
T5	15.641	16.980	16.310
Lsd5%	1.327**		0.938**
Average Transactions	18.140	17.069	
Lsd5%	0.398*		

Table 6*:* Amount of nitrogen lost by volatilization N-NH_3 (kg N ha^{-1}) from wheat plant soil.

Nitrogen budget for wheat plants and intercropping

It is noted from Table 7 of the nitrogen budget for wheat plants and the interference that the inputs were more than the outputs for all the treatments of wheat plants, as well as the treatments of wheat intercropping with the beans. It has a role in reducing the absorption of nutrients, and mineral fertilization has increased inputs, which had a practical effect in reducing output, which may be due to an increase in the washing process, the results of which were not mentioned in the table.

Treatment	**Inputs**				**Outputs**			**Budget**
Wheat	Soil N (original)	N applied	N biofacts	Sum	N uptake	N Volatilize	Sum	
T1	84.4	100	-------	184.4	34.896	20.505	55.401	-
T2	84.4	200	-------	284.4	38.954	22.000	60.954	-
T3	84.4	100	11.20	195.6	49.560	15.436	64.996	-
T4	84.4	100	7.44	191.84	36.555	17.118	53.673	-
T5	84.4	100	34.64	219.09	50.550	15.641	66.191	-
Treatment Intercropping								
T1	84.4	100	-------	184.4	56.493	17.746	74.239	-
T2	84.4	200	-------	284.4	48.322	19.700	68.022	-
T3	84.4	100	35.20	219.6	82.020	12.976	94.996	-
T4	84.4	100	4.80	189.2	77.382	17.946	95.328	-
T5	84.4	100	61.32	245.72	91.137	16951	108.117	-

Table 7: Budget of nitrogen (kg N ha^{-1}) from wheat plant and intercropping.

Discussion

The increase in dry weight in the wheat plant intercropped with the beans is due to the role of the bacteria *A.lipoferum*, as it produces gibberellic acid and gibberellins. This is due to the close relationship between the bacteria and the plant that increases plant growth, and this shows the plant's response to growth as mentioned [22, 23] as *A. lipoferum* forms a symbiotic association with plants to improve crops [24] This growth-promoting activity is also due to the production of indole acid (IAA) and pyruvic acid by yeasts. A significant increase in plant growth was observed in measuring root and shoot length and dry weight [25].

However, the increase in grain yield is attributed to the role of bacteria in increasing the yield through the secretion by bacteria of A.lipoferum Indol-3-ethanol, Indol-3-methanol, cytokinins, and auxins and produces Indol-3-acetic

acid and hormones that encourage root multiplication and growth, which absorb water and nutrients [26, 27,28] Soil with intercropping crops has a strong ability to retain non-metallic nitrogen by fixing N in the soil [29, 30] In addition, promoting plant growth may be due to the ability of yeast to produce amino acids that play an influential role in improving the quality of plants yield, as spraying them at different stages contributes positively to stimulate Physiological and biochemical processes These acids also participate in the construction of proteins and carbohydrates, as they are responsible for cell division and the production of some natural growth hormones such as IAA and GA3 and thus increase the yield and improve the quality [31,32].

The increase in nitrogen concentration in intercropping wheat soil is because nitrogen mineralization rates were higher among leguminous crops and cereals compared to each of them in monoculture [30]. Diverse root exudates and root deposition in the inter-species interaction system [33] suggest that cross-cultivation and nitrogen mineralization were activated because of stimulating microbial activity promoting mineralization of organic soils, especially in intercropping soils containing more organic carbon than mono-crop soils. [33,34]. The reasons for the increase in nitrogen concentration in the wheat plant intertwined with the bean are attributed to the influence of p kg N ha^{-1}ant species on carbon sources in the root zone, which would affect the amount and activity of microbial biomass in these environments [35] and the influential role of yeast as a fertilizer Vital Plant performance can be increased as a result of their production of compounds and plant growth regulators that include indole-3-acetic acid, indole-3-pyruvic acid, gibberellins and polyamines by yeasts [36]. Formation of branches and roots and chloroplast maturation leading to stimulation of vegetative growth

[37] Spraying with different organic extracts showed a significant increase in yield, protein content, photosynthetic pigments, and nutrient uptake of N, P, and K and Fe, Mn, Zn, and Cu compared to the comparison treatment [38]. The production of auxin also contributes to the growth of the lateral root [39] Plant hormones significantly improve the absorption of nutrients and water of the plant with the development of the root system more due to the stimulating effect of plant hormones of Azospirillum strains used in vaccine formulations with their ability to produce plant hormones plays a role A pivotal role in promoting plant growth [40] that inoculation with A.lipoferum strains led to enhanced wheat productivity and increased root length compared to non-pollinated plants, which helped in soil reclamation by improving soil properties [41] The intercropping of wheat and bean can significantly affect the enhancement of ready-made nitrogen through the process of mineralization and nitrification, fixing mineral nitrogen and enhancing the nitrogen cycle, which has improved the nitrogen-retention capacity of the intercropping system on the supply and preservation in the soil and reduce the risks of NO_3 [15].

The optimal nitrogen use rate in intercropping wheat cultivation was 150 $kgNha^{-1}$, which was Less than monoculture wheat, and the optimum yield of intercropped wheat was 20% higher than that of single wheat, which was most likely due to intercropping of wheat with bean as the nitrogen use efficiency values improved [42, 43].

Conclusion

The results showed an excess nitrogen budget in the intercropping cultivation that exceeded the surplus in the monocropping. Furthermore, based on tests, the study showed the isolation of ten bacterial strains from wheat roots grown in sandy alluvial soil. Biochemical traits associated with PGPR are deactivation of the

amine ACC by decreasing ethylene level, siderophore production, acetic acid (IAA) yield and solubility of phosphorous compounds.

References

1 Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M. Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet*. **2013**; *382*:427–51.

2 Ahmad, G., M. Ishaq, S. Khan, R. Ali, K. Afridi, I. A. Khalil, and I.A. Shah. Performance of newly developed wheat advanced lines evaluated under different planting dates for essential traits. Euro. *Acad. Res.* **2015**;*10*:12598-12614.

3 Shirdi, R. A., Hayat, R., Zhang, X.-X., Abbasi, N. A., Ali, S., Ahmed, M., Khattak, J. Z. K., and Ahmad, S. Exploring Potential Soil Bacteria for Sustainable Wheat (*Triticum aestivum* L.) Production. *Sustainability,* **2019**; *11(12),* 3361.

4 Alexopoulos, C.J., C.W. Mims, and N. Black well. Introductory Mycology. 4th Editions. John Wiley and So Long.pp:880. **1996**.

5 AL-Degwy, A. Encyclopedia Production of Medicinal Plants (the first book), Egypt, Tabouli Library, Cairo 280. **1996**.

6 Wanas, A. L. Resonance of faba bean *Vicia faba* L. plants to seed soaking application with natural yeast and carrot extracts. Annals. Agric. Sci. *Moshtohor;* **2002**, *40 (1):* 259-278.

7 Wanas, A. L. Trails for improving the growth and productivity of tomato plants grown in winter. *Annals. Agric. Sci. Moshtohor,* **2006**;*44(3):*466-471.

8 Zaki, N.M., M.S. Hassanein, and K.M. Gamal El-Din. Growth and yield of some wheat cultivars irrigated with saline water in newly cultivated land as affected by bio fertilization. *J. Appl. Sci. Res.* **2007**; *3 (10),* 1121–1126.

9 Ahmed, M.A., A. G. Ahmed, M. H. Mohamed and MM Tawfik. Integrated effect of organic and biofertilizers on wheat productivity In New Reclaimed Sandy Soil. Res. *J. Agric. and Biol. Sci.*, **2011**; *7(1):* 105-114.

10 Mohammed, M. M., and Al-Ubaidy, R. M. Influence of yeast and intercropping system on growth and yield traits of pea. *International Journal of Agricultural and Statistical Sciences,* **2020**; *16(1),* 1577-1580.

11 Abd AL-Hseen, Z. E., and Manea, A. I. Effect of biofertilizer and organic extracts in two hybrids of cauliflower (Brassica Oleracea var. Botrytis). *International Journal of Agricultural and Statistical Sciences.* **2020**, *16(1),* 1651-1659.

12 Baqir, H. A., and Al-Naqeeb, M. A. Response of growth and yield of the three bread wheat cultivars to applying yeast powder methods in different concentrations. *Intern. J. Agric. Stat. Sci*, **2018**; *14*(Sup 1), 327-336.

13 Wezel, A., Casagrande,M., Celette, F., Vian, J.-F., Ferrer, A., Peigné, J., et al. Agroecological practices for sustainable agriculture. A review. *Agron. Sustain. Dev.* **2014**; *34*, 1–20.

14 Jensen, E. S., Carlsson, G., and Hauggaard-Nielsen, H. Intercropping of grain legumes and cereals improves the use of soil N resources and reduces the requirement for synthetic fertilizer N: a global-scale analysis. *Agron. Sustain. Dev.* **2020**; *40*, 1–9.

15 Xu, Y., Qiu, W., Sun, J., Müller, C., and Lei, B. Effects of wheat/faba bean intercropping on soil nitrogen transformation processes. *Journal of Soils and Sediments,* **2019**; *19(4*), 1724–1734.

16 Ali, N. Shawky. Fertilizer Technologies and Their Uses, Ministry of Higher Education and Scientific Research, University House for publishing, publishing, and translation. **2012**.

17 Krieg, N. R and J. Dobereiner . Genus Azospirillum in: Krieg, N. R. and Holt, J. G. (Eds.). Beery's Manual of Systematic Bacteriology, vol. I. pp, 94-104. William and Wilkins, Baltimore, London. **1984**.

18 El-Abagy, H., & El-Greadly, N. Studies on the Effect of Putrescine, Yeast, and Vitamin C on Growth, Yield and Physiological Responses of Eggplant (Solanum melongena L.) Under Sandy Soil Conditions. *Australian Journal of Basic and Applied Sciences,* **2008**; *2(2),* 296–300.

19 Al-Sahaf, Fadel Hussein . Applied Plant Nutrition. Ministry of Education and Scientific Research. The University of Baghdad. Iraq. **1989**.

20 Salem, S. Chalab and N. S, Ali . Manual of Chemical Analysis of Soil, Water, Plants, and Fertilizers. University House for Printing and Publishing - under printing - Ministry of Higher Education and Scientific Research - University House for Printing, Publishing, and Translation. **2016**.

21 Awad, K. Mashhout. Scientific tests of fertilizers and soil fertility. Basra University P - 89. **1984**.

22 Tamboli, A. M.; R.B. Pallavi ; G.C. Sonal; S.. Jai and D.R. Prakash. Effect of Endosulfan on Indole acetic acid and Gibberellin secretion by *Azospirillum SPP* NCIM-2548 and *Azotobacter Spp* Tim-2452. **2012**.

23 Fukami, J.; F. J. Ollero ; C. de la Osa ; R. Valderrama-Fernández ; M. A. Nogueira ; M. Megías and M. Hungria . Antioxidant activity and induction of mechanisms of resistance to stresses related to the inoculation with *Azospirillum brasilense*.J. *Archives of microbiology,* **2018**; *200(8):* 1191-1203.

24 Galindo, F.S.; Teixeira Filho, MCM; Buzetti, S.; Rodrigues, W.L.; Fernandes, G.C.; Boleta, E.H.M.; Neto, M.B.; de Azambuja Pereira, M.R.; Rosa, P.A.L.; Pereira, Í.T. Influence of *Azospirillum brasilense* associated with silicon and nitrogen fertilization on macronutrient contents in corn. *Open Agric* , **2020**; *5*, 126–137.

25 Nassar AH, El-Tarabily KA, Sivasithamparam K. Promotion of plant growth by an auxin-producing isolate of the yeast Williopsis Saturnus endophytic in maize (*Zea mays* L.) roots. Biol Fertil Soils, 42:97–108. **2005**.

26 Zaied, K.A.; A.H.Abd El. Hady; A.E. Sharif; E.H.Ashour and MA Nassef. Effect of Horizontal DNA Transfer in Azospirillum and Azotobactter strains on Biological and Biochemical Traits of Non–Legume Plants .*J. Applied Sciences Research,* **2007**; *3 (1):*73–86.

27 Coniglio, A.; Mora , V. ; Puente, M.; Cassán, F. Azospirillum as Bio fertilizer for Sustainable Agriculture: *Azospirillum brasilense* AZ39 as a Model of PGPR and Field Traceability. In Microbial Probiotics for Agricultural Systems (pp. 45-70). Springer, Cham. **2019**.

28 Purwantisari, S.; S.Parman and K.Budihardjo . The growth and production of potato plants are supplemented by plant growth-promoting rhizobacteria (PGPR). *In Journal of Physics: Conference Series.* **2019**; *1217(1):* 012144. IOP Publishing.

29 Vervaet H, Boeckx P, Boko AMC, Cleemput OV, Hofman G. The role of gross and net N transformation processes and $NH4^+$ and $NO3^-$ immobilization in controlling the mineral N pool of a temperate mixed deciduous forest soil. *Plant Soil.* **2004**; *264*:349–335.

30 Regehr A, Oebermann M, Videla C, Echarte L. Gross nitrogen mineralization and immobilization in temperate maize-soybean intercrops. *Plant Soil* . **2015**;*391:*353–365.

31 Ahmed, F.F., A. H. M. Abdelaal. Salah, E.M.A. El-Masry and W. B.M.M. Farag, Response of superior grapevines to foliar application of some micronutrients, calcium, amino acids, and salicylic acids. *World Rural Observer.* **2014**; *6(3):*57-64.

32 Ahmed, F.F., M.A. Mohamed, A.M.K. Abd ElAal and M.M. Amin. Response of Red Roomy grapevines to the application of amino acids and some micronutrients. The third Conf. of Sustain Agric. And Develop. Fac. of Agric. Fayoum Uni., **2007**; pp: 150-170.

33 Zhang FS, Shen JB, Zhang JL, Zuo YM, Li L, Chen XP. Rhizosphere processes and management for improving nutrient use efficiency and crop productivity: implications for China. *Adv Agron.* **2010**; *107*:1–32.

34 Zhang JB, Zhu TB, Cai ZC, Qin SW, Müller C. Effects of long-term repeated mineral and organic fertilizer applications on soil nitrogen transformations. *Eur J Soil Sci.* **2012**; *63*:75–85

35 Meena, V.S., Mishra, P.K., Bisht, J.K., Pattanayak, A. Agriculturally Important Microbes for Sustainable Agriculture, Volume 2: Applications in Crop Production and Protection. Springer, Singapore. **2017b**.

36 Botha, A. The importance and ecology of yeasts in soil. Soil Biol. Biochem. 43: 1-8. **2011**.

37 Ezz El-Din, A.E. and Hendawy, S.F. Effect of dry yeast and compost tea on growth and oil content of BoragoOfficinalis plant. Res. J. Agric. *Biol. Sci.* **2010**; *6*: 424-430.

38 Sabri, A. M., Mohamed, I. R., Nasrallah, A. E., & Merwad, A. M. A. Response of Wheat Plants to Different or Genic Extracts under Sandy Soil Conditions. *Zigzag Journal of Agricultural Research,* **2019**; *46(5),* 1441-1451.

39 Bruto, M., Prigent-Combaret, C., Muller, D., Moënne-Loccoz, Y. Analysis of genes contributing to plant-beneficial functions in plant growth-promoting Rhizobacteria and related Proteobacteria. Sci. Rep. 4, e6261. **2014**.

40 Oliveira, A.L.M., Santos, OJAP, Marcelino, P.R.F., Milani, K.M.L., Zuluaga, M.Y.A., Zucareli, C., Gonc¸alves, L.S.A. Maize inoculation with *Azospirillum brasilense* Ab-V5 cells enriched with exopolysaccharides and polyhydroxybutyrate results in high productivity under low N fertilizer input. Front. Microbiol. 8, 1873. **2017**.

41 El-Akhdar, I., El-Sheekh, M., Allam, N. G., Kamal, F., Abou-Shanab, R., and Staehelin, C. The potential use of microbial inocula for improving wheat productivity in saline soils. *Environment, Biodiversity, and Soil Security,* **2019**; *3*, 131-146.

42 Xiao J, Yin X, Ren J, Zhang M, Tang L, Zheng Y. Complementation drives a higher growth rate and yield of wheat and saves nitrogen fertilizer in wheat and faba bean intercropping. *Field Crops Research*, **2018**; *211*, 119–129.

43 Chen P, Du Q, Liu X M, Zhou L, Hussain S, Lei L, Song C, Wang X C, Liu W G, Yang F, Shu K, Liu J, Du J B, Yang W Y, Yong T W. Effects of reduced nitrogen inputs on crop yield and nitrogen use efficiency in a long-term maize–soybean relay strip intercropping system. *Plus one*, **2017**; *12*, e184503.

Received: May 15, 2023/ Accepted: June 10, 2023 / Published: June 15, 2023
Citation: Mohammed, H.A.; Hasan, K.U. Effect Of Bacteria And Yeast Bio Fertilization On Nitrogen Budget, Growth, And Yieid Of Wheat (Triticum Aestivum L.) When Intercropping With Faba Bean (Vicia Faba L.). Revis Bionatura 2023;8 (1) 79. http://dx.doi.org/10.21931/RB/CSS/2023.08.01.79