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The effect of *Pseudomonas fluorescens* and Salicylic acid and their synergistic effect in growth, yield and some physiological characteristics of two varieties of *Triticum aestivum* L. plant

A Thesis Submitted in Partial Fulfillment of the Requirements for the
Master's Degree of Science in Biology

By

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿وَأَلْقَىٰ فِي الْأَرْضِ رَوَاسِيَ
أَن تَمِيدَ بِكُمْ وَأَنْهَارًا وَسُبُلًا
لَّعَلَّكُمْ تَهْتَدُونَ﴾

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I certify, that this thesis entitled “**The effect of *Pseudomonas fluorescens* and salicylic acid and their synergistic effect in growth, yield and some physiological characteristics of two varieties of *Triticum aestivum* L. plant** ” and examined the student ” **Hussein Mohsen Hameed** ”, under my supervision in Department of Biology, College of Science University of Muthanna, as a part of the fulfillments of requirements for the degree of Master of Science in Biology/general biology.

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Date : / /2021

Dedication

I dedicate this little effort :

**At the beginning, give God Almighty the gift of a
great one to me**

**to the Prophet, Muhammad, and to AL-Imam, Ali ,
who inspired me on the path to knowledge**

**And to the spirit of my dear father, who was the
reason that I reached to this point**

**And to my dear mother, who did not forget me from
her love and prayers to me at all times**

**And to my dear wife Russell and to my children, Ali
and Mohsen**

Hussein-2021

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Abstract

The experiment was conducted in a greenhouse at department of biology , College of Sciences ,Al Muthanna University during the grown season in December 2020-2021. the concentrations of salicylic acid were used in the study at (0,50, 100 and150) ppm and *pseudomonas fluorescens* at (10^5 , 10^6 , 10^7) c.f.u./ml on growth and some physiological of the two varieties of *Triticum aestivum* L. included Abu-graib and Abaa 99 the project was carried out according to the completely random design (C.R.D) in three replicates. The results indicates the significant effect of *pseudomonas flourescens* and salicylic acid at for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), variety Abu-graib was more response than Abaa 99 on vegetative growth parametars like leaf area (26.42) cm^2 , Dry shoot , root (1.239 , 0.610) g ,plant height (64.50) cm ,root length (60.13) cm, fresh weight of shoot and root (4.55 , 1.20) g respectively , and the physiological parameters like chlorophyll a,b,a/b,a+b and carotene in addtionally the other parameters like relative water content 90.63%, membrane stability 10.18% , ion content of nitrogen 1.190% potassium 2.370 %Magnesium 1.023% calcium 0.236% phosphate 0.518%, carbohydrate (55.553) mg/g, protein (7.427) mg/g, the permeability of ion like Na^+ , k^+ salicylic acid was showed positive effects in reducing of permeability of K^+ and Na^+ ions 8.75%.while (SA1+PF1) reducing of permeability of Na^+ ions 17.383%. and the yield parameters like hundred grains weighed (3.104) g,number of tillers/plant (3.875) and also single effect *pseudomonas flourescens* and SA on *Triticum aestivum* . however, according to find, exogenous application of *Pseudomonas flourescens* and SA is improve vegetative growth parametars, physiological, yield aspects especially when combined.

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List of Abbreviations

Abbreviations	Terms
SA	Salicylic acid
ABA	Absciscic acid
Con.	Concentration
Sp.	Species
ppm	Parts per million
chl.	Chlorophyll
DAS	days after sowning
PGPR	Plant Growth-Promoting Root Bacteria
PGR	plant growth regulators
chl-a	chlorophyll a
chl-b	chlorophyll b
Cfu/ml	Colony forming unit / Millimeter

1. Introduction

The Mesopotamian civilization is the first settlement for the people to grow wheat plant on the face of the earth to this plant from food and economic returns, and its cultivation has been derived from the land of Iraq to this day, where the latest statistics 2020 cereal production is forecast at an above-average level of 6.5 million tonnes, slightly below 2019 near-record level of 6.8 million tonnes. Average import requirements forecast cereal import requirements in the 2020/21 marketing year (July/June) are forecast at 4.2 million tonnes, including 2.7 million tonnes of wheat (imported mostly as flour) (FAO ,2020).Wheat plant *T. aestivum* L. is one of the world's most important staple crops, occupying 17 percent of all planted land and growing in a range of environments (Consortium ,2014) . Wheat plant *T. aestivum* L. is one of the most cultivated and spent human crops (Zahoor *et al.* 2020).

Pseudomonas fluorescens is a natural bacteria found in soils that has a variety of characteristics that make it a successful candidate for Plant Growth-Promoting Root Bacteria (PGPR). Fluorescent *Pseudomonas* spp. have proved to be the most important *Pseudomonas* strains. A lot of work has been done around the world to activate the promise of one form of bacteria called fluorescent *pseudomonas* (Lata *et al.* 2002) . *Pseudomonas* spp. has been recognized as a possible PGPR for improving agricultural crop development. They can also tolerate dry weather, making them suitable for rain-fed agriculture. (Saharan & Nehra 2011).*Pseudomonas fluorescens* is a non-pathogenic bacterium that shares the capacity to make pyoverdines(PVDs) with additional *Pseudomonas* (Ringel and Brüser 2018) .

Salicylic acid is a plant hormone that regulates a several of aspects of plant growth and development, and also the creation of defenses against biotic and abiotic stress. In 1933, it was suggested that plants could develop acquired immunity after being infected with a pathogen(Ku *et al.* 2018) . (SA) has also been discovered to play a role in how plants react to abiotic stresses including drought, chilling, heavy metal toxicity, heat, and osmotic stress. In this way,(salicylic acid) tends to be an important medicinal agent for plants, much as it is for mammals. Apart from its function in biotic and abiotic stress, salicylic acid is important for the control of physiological and biochemical processes during the plant disease's lifetime. (Rivas-San Vicente and Plasencia, 2011;Zhang and Li, 2019).

Salicylic acid works as a non-enzymatic antioxidant as well as a plant growth regulator (PGR) , regulating a number of physiological processes in plants. Salicylic acid is associated with the activation of the stress-induced antioxidant mechanism, induces flowering in many species, enhances flower life, and regulates ion uptake through roots and also stomatal conductivity (Muthulakshmi and Lingakumar, 2017).

1.2: The Aims of The Study:

Explanation of the synergistic between salicylic acid and *Pseudomonas flourescens* effect on growth, some physiological , and yield in wheat plants .The changes that occur in terms of response to the treatment with salicylic acid and *Pseudomonas flourescens* for two varieties of wheat and detect any concentration is better .

2- Literatures Review**2-1 Wheat plant (*Triticum* spp.)**

One of the important monocots of the Poaceae family is the wheat plant ,Wheat can be divided into five main types:

- 1- diploid einkorn (genome AA).
- 2- tetraploid emmer.
- 3- durum wheat (AABB) , (pasta wheat or macaroni wheat).
- 4- hexaploid common wheat (bread wheat).
- 5- spelt (AABBDD), (dinkel wheat or hulled wheat), A man-made cross of durum wheat and rye is called Triticale (AABBRR) (Wieser, *et al* 2020) .

2-1-1 Morphology of Wheat plant (*Triticum aestivum* L.)

The mature wheat plant is the culmination of all processes of development and growth during the entire life cycle. All structures, such as leaves, tillers, and ears, reach full size but not all can mature because some of the structures shrunk and may rotted away and blown away, particularly those created earlier in the life cycle. A root and shoot system consists of the plant. The seminal roots and the nodal (adventitious or crowned roots) rooted in the lower nodes are two types of roots. The shoot consists of several reproductive units or phytomers, each potentially comprising a node, a leaf and an extended internode as well as a bud within the axil of the leaf. The elongated internode is between 4 or even 7 of the most distal units. The elongated stem or culm is the portion of the shoot with elongated internodes. The internodes are shorter and the nodes are packed together closely in the proximal or basal units. each node has a leaf inserted, though the basal leaves usually die at maturity and may be gone. The

shoot is closed by an ear or spike . The phytomer in the Ear is composed of the spikelet and the rachis; the growth of the leaf is suppressed.

The basal leaves axils develop tillers of the same basic structure as the main stem. Just some of the evolved tillers live to produce an ear in the process of anthesis. Many die and in the mature plant can be difficult to locate. Every blade consists of the sheath and a lamina, wound around the leaf (blade). The membrane, ligule, and a couple of thin, hairy Protrusions of the auricles at the junction of the sheath and lamina. To form a rough knot or pulvinus, the base of the leaves on the culm is thickened. The elongated distal internodes rise in length from the basal to the most distal, the peduncle (Kirby 2002) .

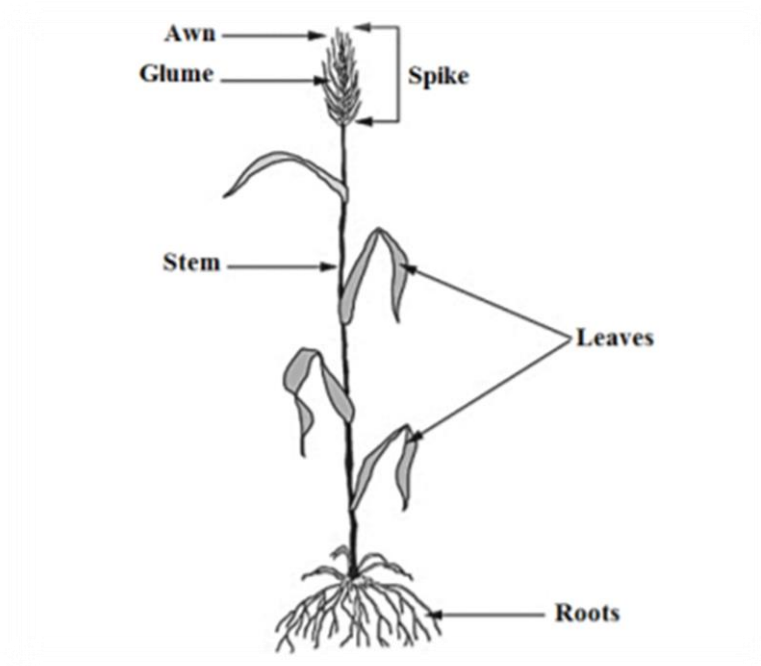


Figure (2.1) : Morphology of wheat plant *Triticum aestivum* (Khan and Mubeen 2012).

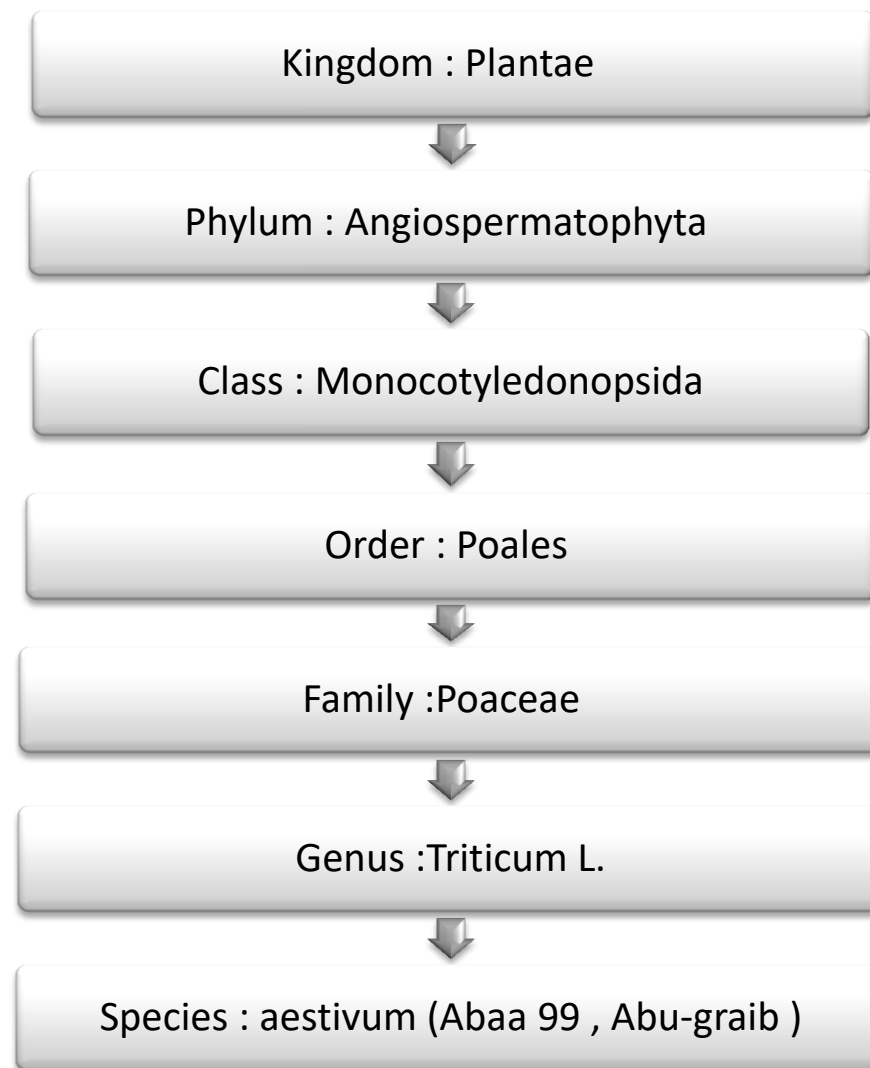
2-1-2 Classification of Wheat plant (*Triticum aestivum* L.)

Figure (2.2) : Classification of Wheat plant (*Triticum aestivum* L.) Adapted and modified from (Bálint, *et al* 2000)

2-1-3 Economic importance of Wheat plant (*Triticum aestivum* L.)

Wheat is a grain crop that has a significant economic importance as a cool season's cereal because of its high yield potential (Chenu *et al.* 2017). Besides rice (*Oryza sativa* L.) and maize (*Zea mays* L), wheat provides more than 50 % of human calorie and is a main food source in regions that have a significant

population rise, such as Latin America, Africa and Asia (Donn *et al.* 2015) . But during the last decade > 50% of the consumption of wheat from other countries has been imported from Brazil (Conab, 2019).

Agriculture has to grow more to be environmentally friendly with less resources as the world population grows exponentially. Crop models are valuable tools in the context of designing conditions to forecast crop outcomes. from the 1960s Wheat (*Triticum* spp.) Crop models have become statistical algorithms in order to convert plant development and production-based processes. They have been used for agricultural purposes for decades and recently have been implemented into environmental footprint modeling growth, biotic restrictions, phenotype and gene effects, the influence of climate change and the rise in effects of global change (Chenu *et al.* 2017).

2-1-4 Environment of Wheat plant (*Triticum aestivum* L.)

Temperature, precipitation, and enhanced CO₂ level in the atmosphere, the three climate change drivers are not only going to influence growth of crops like wheat directly at the plant level but also through indirect effects at the system level, for instance through changes in properties and processes in soils being used as medium for plant growth, shifts in nutrient cycling, crop–weed interactions, insect pest occurrence, and plant diseases. Several simulation models have projected reduced wheat yields in the emerging climate change scenarios (Jat *et al.* 2018) .

Changes in the existing atmosphere also brought about temperature and precipitation changes which have led to extreme drought. This ecological

fluctuation triggered an increased global warming, leading to a rise in irrigation demand (Khan *et al.* 2019) .The population growth, on the other hand, led to significant loss of prime cropland by rising soil degradation and urbanization. Soil with a minimum potential for crop growth and production is therefore highly necessary (Vymazal 2007) .

The relation to the geographical dispersal of demand the geographical concentration of major grain supply indicates that the trading, especially for wheat and maize, would be important in meeting grain needs. The most activity in the temperate regions of advanced countries, Emerging economies' expanded demand has improved export dependence Three grain crops, wheat, maize (corn) and rice rule foreign agriculture, with a combined annual yield of more than 2000 million tons (FAO 2013) .

2-1-5 The nutrietional value and importance Wheat plant (*Triticum aestivum* L.)

Wheat is one of the important foodborne pathways for human intake of lead, and it is the most world widely grown and consumed staple food, especially in (Asia and Europe) (Chen *et al.*, 2020 ; Liu *et al.*, 2016) .A comparatively limited variation is provided in the chemical compositions of mature grains of wheat water content by 13% . Carbohydrates are the primary category of components followed by proteins (11%), primarily starch (DN 58%), and nontarch polysaccharides (13%). Minor constituents include lipids (2%) and minerals (2%).The content of vitamins and phytochemicals is very low (<0.1 %) but essential because of their biological value. Starch is available as granules and contains two primary compounds of

polysaccharide, amylose and amylopectin. Nonstarch polysaccharids (dietary fiber) include arabinoxylan, cellulose, and β -glucans cellular wall polysaccharides as well as fructans and peptides of arabinogalactan. Grain proteins can, according to their various functions, be divided into four classes: storing of (gluten) proteins, metabolic proteins and ordinary proteins, and miscellaneous proteins with additional unique functions. The proportion of lipids is classified into the nonpolar lipids, phospholipids and glycolipids. Potassium, phosphorus, magnesium and calcium are the main minerals, followed in less concentrations by zinc, manganese and iron. Wheat grains are major B vitamin including nicotinamides, pantothenic acid, thiamines, pyridoxines, riboflavin, vitamin E (α -tocopherol), can. Phytochemicals be structurally divided into four major classes. Phenolic compounds, terpenoids, carotenoids and flavonoids (Wieser, *et al* 2020).

2-2 : Salicylic Acid (SA)

Salicylic acid is a critical plant hormone that governs certain facets of plant development and growth as well as the activation of biotic and abiotic stress defenses. Here, After pathogen infection, the capacity of plants to develop acquired immunity was first suggested in 1933. In the last three decades, however, much of our information about plant immune signaling has been developed, following the discovery that SA is an endogenous defense signal. Researchers have established during this process :

- (1) Two routes by which SA can be synthesized,
- (2) various proteins which control the synthesis and metabolism of SA .
- (3) some of the signaling components that act downstream of SA, including a significant number of SA targets or receptors. Furthermore, it has become

increasingly clear that SA does not itself signal immune responses, but rather as part of a complex network comprising several other plant hormones. Therefore, future attempts to establish a thorough understanding of SA-mediated immune signaling would need to close the information gaps that exist within the SA pathway itself and explain how crosstalk among the various hormone signalling pathways contributes to an immune response that, depending on the identity of the attacking pathogen, is both robust and tailored for optimum efficacy(Klessig, *et al* 2018).

The first commercial production of synthetic SA started, In 1874, in Germany(Asghari and Aghdam, 2010). The Bayer Company developed aspirin, a similar analog of salicylic acid, in 1898 and it quickly became one of the world's most common medicinal preparations. Many compounds belonging to the salicylate group were isolated from a number of plants during the 19th century. Aspirin, a trade name for acetylsalicylic acid (ASA), is spontaneously exposed to SA hydrolysis. It is easily translated to SA when added exogenously. It is commonly used by many plant scientists in their studies, despite the fact that aspirin was not known as a natural product. In their physiological effects, the cause is the similarity (El-Magbri 2014) .

2-2-1: Chemical Structure of Salicylic Acid.

Salicylic acid is an aromatic ring that comprises a hydroxyl group or its plant equivalents, and is one of the many phenolic compounds. The results of external salicylic acid were shown to include closing of the stomata, seedlings, fruit formation and sugar depletion for a wide variety of farming activities. It is soluble antioxidant in water and can control the growth of plants. It is also essential to withstand non-biotic stress, such as drought tolerance of wheat.(Muthulakshmi and Lingakumar 2017) .

Salicylic Acid is a crystalline powder. Phenolic is generally known as an aromatic ring containing or acting as hydroxyl group. It is mildly soluble in water and very soluble in polar organic solvents in 157 -159 c (Ekinici, *et al.*, 2011). Since ancient times, herbal salicylate has been used in medicines. A diverse group of phenolic plants contains salicylic acid or ortho-hydroxybenzoic acid with related derivatives. In 1828, in Munich, there was a small volume of salicine isolated (Raskin, 2003). Salicin (C₁₃H₁₈O₇) is a D-glucose alcoholic beta glycoside produced by all barks of willow. (Ashraf *et al.*, 2010), Willow bar, with anti-inflammatory practices. Salicyl alcoholic glucoside. 10 years hence, the Latin term *Salix* for willow tree was renamed "SA" by Raffaele Piria. The first commercial production of synthetic SA was initiated in Germany in 1874. (Popova, *et al.*, 1997).

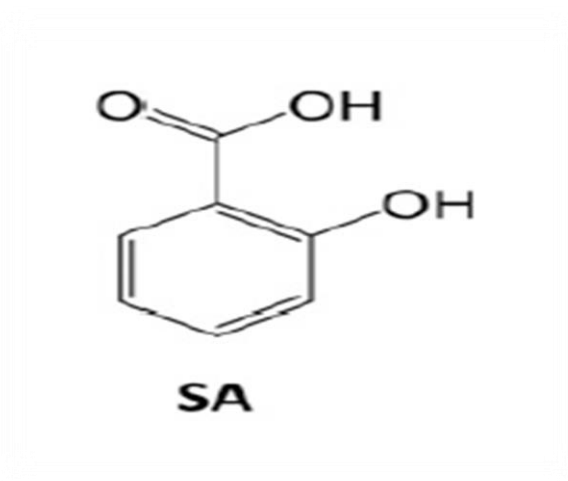


Figure (2.3) : chemical structure of Salicylic Acid (Klessig, *et al* 2018)

2-3 *Pseudomonas fluorescens*

Pseudomonas fluorescens is one of the most important environmental bacteria that lives in soils, water and plant surface or rhizosphere (Kai *et al.*, 2007; Wallace *et al.*, 2017). These bacteria are straight or slightly curved bacilli, move by a polar flagellum it don't produced by spores , compulsive air and grows in a range of

temperatures between (4 - 42 °C) and a pH range (7-9) and is capable of exploiting a variety of sources of carbon as an energy source (Atlas B, 1984) .

2-4 :Effect of Salicylic Acid and *Pseudomonas fluorescens* in vegetative growth :

Dehghanian *et al.* (2020) found that plant growth and root tissue following the application of SA and *Pseudomonas fluorescens* to healthy, infected tomatoes on plant leaves. Including the number of embryos, egg mass and reproductive component, general use of SA and Pf. revealed that SA and Pf increased plant growth parameters and decreased infection with *Meloidogyne javanica* in tomato plants .

The findings revealed that PGPR and plant growth regulators (PGR) treated chickpea plants greatly increased the quality of chlorophyll, protein and sugar. In the treated seeds, fresh and rooted (81 %) and dry (77 %) weights were also increased substantially. In response to drought stress, the content of leaf proline, lipid peroxide and antioxidant enzymes increased, but declined due to PGPR. Farm height (61 %), grain weight (41 %), amount of nodules (78 %), pods (88 %), plant yield (76 %), weight of pods (53 %) and overall biomass were used (54 %). Increase in PGPR and PGR treated chickpea plants grown in sandy soils. when used with PGPR, PGR (SA and Put) had little or marginal function in accumulating leaf protein material. (Khan, Bano, and Babar 2020) .

Systemic resistance chemicals applying along with biological control agents will be an effective alternate approach to enhance the management of rice blight. The effect of salicylic acid and *Pseudomonas fluorescens* on Paddy growth and yield was investigated in this report. Maximum growth and yield were observed in

the treatment *Pseudomonas fluorescens* seed + salicylic acid added on the 30th day , among the different treatments studied, and the lowest treatments were reported in the comparison therapy (Usharani *et al.* 2014) .

PGPR inculation has substantially improved yield parameters : plant height, spike length, grain yield and weight , improved fertility status for sandy soil. Inoculation of PGPRs also increased the deposition of macronutrients, complete NO₃-N and P concentration, and soil moisture content in ambient root soils. The cumulative effects of PGPR and PGR have been concluded to have a profound influence on the biochemical responses and drought resistance of wheat grown in sandy soils . SA and Put's complementary results with PGPR bioinoculants could be more likely to improve plant biomass and grain production with higher grain sizes. In all groups, joint inculation with all three PGPRs and two PGRs was more effective than for each other treatment. The combined treatment of PGPRs and PGRs significantly enhanced (59 % , 41 %) per hectare yield in both the sensitive and tolerant varieties. The increase was 45 % greater than other drought prone areas of Pakistan which has an average yield of 1.25 tonnes/ha compared to 2.3 tonnes/ha in PGPRs/PGRs treated plants. In order to improve soil moisture (Khan, Bano, and Babar 2019) .

SA and mycorrhizal fungi significantly increased the shoot and root biomass and also the number of soil bacteria, dehydrogenase activity, and fluoranthene . At the highest concentration of fluoranthene, as a result of salicylic acid and mycorrhizal fungi, either alone or in combination, have a significant effect on the improvement of phytoremediation potential in tall fescue (Rostami and Rostami 2019) .Exogenous application of SA, Fe(II) and *Burkholderia* sp. increased biomass of root, stem . Among all treatments, (SA+Fe+B) exerted the best

performance. but only SA and *Burkholderia* sp. That treatment increased pigment contents and photosynthetic performance in Cd sensitive genotypes (Wei *et al.* 2018) .

The growth and production characteristics of *Ocimum basilicum* L.SA, bio fertilizer *Azospirillum spp* and SA, bio fertilizer and their relationship. At 1%, the effects of different treatments on shoot and flower number, root and shoot dry and fresh weight, relative water content, and electron leakage were important. Under water tension, SA and *Azospirillum* inoculation improved basil growth and production.(Falaknaz, *et al* 2014).

Pseudomonas sp. inoculated RPEC1: rock phosphate, poultry litter, *Pseudomonas* sp. on wheat production and soil chemical, biological, and biochemical properties, Billah showed substantial improvements in grain agronomic and physiological parameters (Billah *et al.* 2020) .

Moharekar *et al* (2003)pointed out that the rise in wheat yield, the number of grains and grain weight was caused by salicylic acid spraying that improved its vegetable properties. the use of plant growth organizations including SA shows a significant role in the plant growth transition along with its morphological changes as plant height, scientific paper area, total chlorophyll, length and weight of the spike increases. .The more leaves and fresh and dry mass raised from grains soaked at (10^{-5} M) SA, compared with water soaked, managed, controlled wheat seedlings (Hayat *et al.*, 2005).

Jediaa *et al* (2009) found that the efficacy of using *Pseudomonas fluorescens* as a biological fertilizer resulted in a (13.0 and 12.9 %) increase in seed germination of the Mexican wheatgrass cultivar for two successive seasons and the

yield improved by 36.7 % (4120 kg.h⁻¹) when the seeds were prepared with dry preparation and accompanied by treatment control .

Pseudomonas spp. A biological fertilizer that stimulates the growth and development of the wheat plant can be mixed or blended with other bacterial strains to form .The root system of both crops was colonized by *Pseudomonas* Spp. and it continued at sufficient population densities. A important influence on the promotion of plant growth , which was reflected in the yield. Another linked result is that, when inoculated with *Pseudomonas* spp, both crops yielded higher yields with lower doses of fertilization than those usually applied. This illustrates its future application as a reasonable solution to crop production while mitigating the effect on the environment (Rosas *et al.* 2009) .

Abed *et al.* (2016)revealed that *Pseudomonas putida* and *Pseudomonas fluorescens* were successful in stimulating wheat plant growth as the inoculated plants surpassed them in plant height and dry weight characteristics for their vegetative and root classes of wheat .

The use of root bacteria for the promotion of plant growth (PGPR) as inculation is a biological solution to sustainable development , In order to determine the effect of stimulating field growth when added to maize and wheat seeds at the time of sowing, *Pseudomonas aurantiaca* has been formulated as an inculator and included in the assays were P and N fertilization treatments. Impact on spring wheat (*Triticum aestivum* L. cv. Laura), grown under gnotobiotic and non-sterile situations, of associations between Pseudomonads (*Pseudomonas cepacia*, *P. aeruginosa*, *P. fluorescens*, and *P. putida*) and Mcorrhizal arbuscorrhizal *Glomus clarum* (Nicol. and Schenck) NT4 isolate. Positive pseudo-

pollination responses were usually obtained under gnotobiotic conditions, while plant growth responses were variable. The imager's dry weight gain ranged from (16% to 48%) , while the percentage of root enhancement ranged from (82% to 137%) . In unsterilized soils, however, plant growth was not impaired by pseudo-inoculations or decreased by up to 24 percent ,38 percent rise in root growth . Important pseudomonad-G interactions. Treatments for clarum NT4 have been revealed. The severity of the response associated with any single-applied organism is typically influenced by double pollination. The influence on the germination of G by this pseudomonads . Clarum NT4 Spore has been studied (Walley and Germida 1997).

The impacts of various SA levels : (0, 100, 300, and 500) ppm on germination and seedling vigor of three wheat varieties: Giza 168, Sakha 94, and Gemmiza 9 under salinity stress situations and during 2011–season. In the meantime, When opposed to untreated seed and other applications, treatment wheat seeds with Hundred ppm SA enhanced germination requirements , seedling characteristics and also chemical and physiological parameters with saline conditions. Just field emergence percent, number of spikes/m² had a noticeable impact on yield when SA was used at (100) ppm. Crop processed with (300 or 500) ppm SA , on the other hand, was the weakest. seed treatment with 100 ppm SA increased seed germination and seedling vigor, field emergence rate, yield, and alleviated the harmful effects of salt (Yousof and El-Saidy 2014).

2-5 : Effect of Salicylic Acid and *Pseudomonas fluorescens* in physiological characters :

Salicylic Acid influence different physiological processes ,The role of SA in plant growth and development include flowering, ion uptake, stomatal regulation and photosynthesis is analysed. SA as a natural inducer of thermogenesis and disease resistance in plants (Popova, *et al* 1997b) .Endogenous and exogenous salicylic acid strengthen the physiological properties and this depends on the SA concentration and its distribution to plant species .

Beneficial effect of the integrated application of *P. putida* and SA on plant growth parameters was significantly evident. The highest values of glucosinolates, total phenol, and flavonoids were recorded in (*P. putida* + SA). Canola plants treated with (*P. putida* + SA) are more resistant to the cabbage aphid pest. These findings demonstrated that SA integrated with *P. putida* on canola plants act effectively for reducing the population of *B. brassicae* and can be used in integrated management programs of this pest (Khoshfarman-Borji, *et al* 2020) .

Salicylic acid and cell extracts of *Corynebacterium glutamicum* and *Saccharomyces cerevisiae* as a supply of hormonal and inducer compounds were applied on the foliage of the 10-days-old rice plants and subsequently observed the colonizing ability of ZSB15-M2. The cell extracts of *Corynebacteria* and yeast showed a 100-fold increase in the ZSB15-M2 population in the rhizosphere of rice, whereas salicylic acid had a 10-fold increase in relation to mock control. The rice root exudates collected after the spraying of salicylic acid and microbial extracts showed significantly enhanced release of total carbon, total protein, total sugar, total amino nitrogen, total nitrogen, and phenol content. In vitro assays revealed

that these root exudates collected after exogenous spray of these chemicals enhanced the chemotactic motility and biofilm formation of ZSB15-M2 compared to the control plant's root exudate (Bowya and Balachandar 2020) .

Cappellari demonstrated that methyl jasmonate (MeJA) or SA application combined with inoculation with PGPR constitutes an advantageous management practice for improving the production of secondary metabolites from *M. piperita*.(Cappellari *et al.* 2019).

The yeast *Hanseniaspora uvarum* alone or in combination with salicylic acid or sodium bicarbonate was investigated for control of gray mold, postharvest quality and antioxidant enzymes of grapes. The results indicated that the treatment of *H. uvarum* suspension of 1×10^8 cfu/ ml combined with either (2 mmol /L SA or 2%)SBC resulted in a remarkably improved control of *Botrytis cinerea* infections on grapes. Disease incidence and lesion diameter in treated fruit by *H. uvarum* alone or combined with SA or SBC were significantly lower than those of the control fruit . Integration of *H. uvarum* with SA and with SBC both significantly reduced the browning index, the decay incidence, weight loss while maintained the fruit appearance, firmness, total soluble solids (TSS) and titratable acidity (TA) of the grapes . Enhanced control by SA or SBC could be due to either induced resistance or direct effects of these chemicals on *Botrytis*. The proper combination of *H. uvarum* and chemical reagent can thus provide an effective strategy to reduce postharvest decay of grape berries (Qin *et al.* 2015) .

2-5-1 : Effect of Salicylic Acid and *Pseudomonas fluorescens* in Chlorophyll and Carotene Content.

chlorophyll plays a very significant role as a natural pigment in the absorption of light energy and growth promotion. Plant chlorophylls and carotenoids are highly colored, conjugated polyenes that play central roles in photosynthesis (Fahey *et al.* 2005). Strong chlorophyll content and photosynthetic intensity could be responsible for improved dry matter accumulation in wheat seedlings under drought, coupled with elevated Rubisco activity of SA treated plants (Singh and Kalidindi 2003).

All species for mango, Kumari found that the (0.5 %) chitosan and (0.4%) SA treatment increased chlorophyll fluorescence, leaf area, photosynthetic pigments, proline, and total phenol content the most compared to the control (Kumari *et al.* 2021).

Mean data recorded for chlorophyll contents in flag leaves of wheat crop showed that there was a significant difference. Among the un-inoculated treatments, RPEC1 showed the highest (28%) increase which was 2%, 6%, 12% and 25% higher than FDP, RPEC2, SPLC and HDP, respectively. Seed inoculation with *Pseudomonas* sp. resulted in an increase (4%) in chlorophyll content over un-inoculated treatments. However, the interactive effect of treatments (PGPRs fertilizer) showed 29% increase followed by FDP (27%) over un-inoculated untreated control. While the treatment RP showed a nonsignificant difference when applied in combination with *Pseudomonas* as well as *Proteus* sp. (Billah *et al.* 2020)

Foliar application of SA increased the bacterial population of BF significantly compared to the sole application of BF under irrigated as well as drought stress conditions. Co-application of BF and foliar spray of SA induced drought tolerance

in wheat plants by enhancing plant biomass, photosynthetic pigments, relative water content and osmolytes, and activities of the defense-related system. Plants treated with SA and BF together under drought stress had significantly increased leaf water status, Chl a, Chl b, and carotenoids synthesis by 238%, 125%, 167%, and 122%, respectively. Moreover, the co-application of SA and BF showed maximum SOD, POD, APX, and CAT activities by 165%, 85%, 156%, and 169% in the leaves while 153%, 86%, 116% and 200% in roots under drought stress. Similarly, the combined treatment exhibited a pronounced decrease in MDA content by 54% while increased production of proteins and proline by 145% and 149%, respectively. Our results showed that the co-application of SA and BF induced better drought tolerance as compared with the sole application of SA or BF. The results obtained herein suggest that combined application of BF and SA can be applied to the wheat crop to greatly improve drought tolerance in field conditions (Azmat *et al.* 2020) .

A large increase in the chlorophyll content of the sensitive cultivar was seen in plants treated with *P. chinense* and sprayed with SA and putrescine . Also under extreme environmental conditions, plants treated with PGPR and PGRs displayed a substantial improvement in chlorophyll, sugar and protein content. The development of proline, antioxidant enzymes and lipid peroxidation was increased by dehydration stress, but a decrease in the biochemical content of the inoculated plants i.e. chlorophyll, protein and sugar was observed (Khan,*et al*2019).

The synthesis of carotenoids, xanthophylls and the rate of de-epoxidation was enabled by salicylic acid, but the amount of chlorophyll pigments both in wheat and moong plants and the ratio of chl- (a / b) in wheat seedlings was reduced (Moharekar *et al.*, 2003).SA plays a protective role on wheat against herbicide stress , Akbulut

findings showed that exogenously SA and selenium application decreased the negative effects of herbicide on the parameters such as :lipid peroxidation, carotenoid, total chlorophyll and total phenolic , understanding the defense mechanisms in plant species resistant to stresses would be an important step for decreasing product losses (Akbulut *et al.* 2018) .

The application of SA alone enhanced the chlorophyll content and photosynthetic rate and also neutralized the negative effect of the stress . The increase in the photosynthetic rate by SA may be the result of enhanced activity of Rubisco and PEP carboxylase under stress (Popova *et al.* 2003; Singh and Usha 2003) .Fariduddin *et al* (2003) reported that lower SA concentrations have been shown to be helpful in improving plant photosynthesis, growth and various other physiological and biochemical features. In the other hand, SA itself might induce a high degree of stress in plants at higher concentrations. It also implies that SA changes the different physiological roles and biochemical processes of plants in order to control their development and production in the light of a shift in the ecosystem of plants. In comparison, in the experimental groups opposed to the control sample, plants that were pre-treated with SA displayed, comparatively higher physiological parameters (Chl. & Carotene) values (Kaya and Yigit; 2014).

Shinwari *et al* . (2018) discovered that different amounts of acetyl salicylic acid were tested for thermo-tolerance induction in tomato seedlings with exogenous use, suggesting that chlorophyll content was greatly influenced by both ASA treatments and growing conditions. The application of SA (20 mg/ ml) to the foliage of *Brassica napus* plants increased the chlorophyll quality (Baghai *et al.*, 2002) . Similarly, soaking wheat grains in (10^{-5} M of SA) resulted in higher pigment quality plants, which decreases as the SA concentration is higher than that (Hayat *et al.*, 2005). In

comparison, 30-day-old *Brassica juncea* plants sprayed with 10⁻⁵ M of SA had 20 percent higher chlorophyll than those sprayed only with water. The overall concentration (10⁻³ M), however, decreased the chlorophyll content at the 60-day level and the values were below those of water spray management (Fariduddin *et al.*, 2003). Maize and soybean leaves added with acetyl salicylic acid (ASA) or gentisic acid (GTA) did not, however, display any improvement in their chlorophyll content (Khan *et al.*, 2003).

Increased pigment content of plants under non-salinity and salinity conditions has been found in SA treatments. Foliar spray with salicylic acid, (Chl .a, b) and carotenoids increased under natural field conditions in bean plants (Türkyılmaz *et al.* . 2005). Pancheva *et al.* .(1996) found that long-term (7 days) treatment of barley seedlings with SA lowered the rate of photosynthesis chlorophyll content, whereas short-term 2 hours treatment did not impact the content of chlorophyll relative to underground control plants. (Zhou *et al.* . 1999) stated that with SA application, photosynthetic pigments in maize increased. In addition, (Khan *et al.* . 2003) found that SA increased the photosynthetic rate in maize and soybeans. Higher chlorophyll content was seen in seeds pretreated with a 10⁻² mol /L SA solution. These findings are in line with those obtained by another scientist, showing that SA substantially increased the salt stress pigment content (El-Tayeb 2005)

Strong chlorophyll and photosynthetic content The rate of improved dry matter accumulation in wheat seedlings under drought can be responsible for the high Rubisco activity of SA handled plants(Wang and Zhang 2017) .Plants receiving SA alone had the highest SPAD chlorophyll benefit and measured a slightly higher 27.5 percent (pB0.05) than that of the monitor. The application of water stress to the plants, however, decreased the SPAD value. The adverse effects produced by water

stress (20-day stage) and almost entirely by water stress at the 30-day stage were partly resolved by follow-up treatment with SA (Singh and Kalidindi 2003) .

Ahmed *et al.* (2020) explored that seed priming by 0.3 mM improved TSS, SOD and chlorophyll contents from 13.7 to 15.0 mg g/1 FW, 4.64 to 5.38 activity h/1 100 mg/1 and 89 to 102 ug g/1 compared to untreated seeds, respectively . Treatment of wheat seed with (100 ppm) SA had a beneficial effect on physiological markers such as chl a, chl b, and carotenoids :1.98 mg /g,1.25 mg /g and 0.65 mg /g fresh weight in wheat plant (Yousof and El-Saidy 2014) .

2-5-2 : Effect of Salicylic Acid and *Pseudomonas fluorescens* in minerals

The conjunction with Plant Growth-Promoting Root Bacteria, SA and Putercine were added alone as well as (PGPR). For seedlings, growth regulators (PGRs), SA and Put (150 mg / L) were applied (chickpea seed). Three-leaf-stage foliar mist. Khan revealed that SA and Put-treated plants individually or in combination with PGPRs greatly increased the concentration of heavy metals in plant stems. The heavy metal and macronutrient-induced PGRs in the chickpea bud and in the roots is increased by PGPRs (Khan and Bano 2018).

Combined treatment of PGPR and SA increased the Cu (21%), Co (11%), and Zn (8%) accumulation , Inoculation of plants with PGPR significantly increased shoot length (60%), root length (68%), root fresh (61%), and dry (63%) biomass under water stress. The inoculated plants had increased chlorophyll (67%), carotenoid (70%), leaf protein (64%), sugar (64%), and phenolic (62%) contents while lower leaf proline (62%) content, malondialdehyde (MDA) (64%), and antioxidant enzymes (67%) which suggest their role in drought tolerance. It is

concluded that integrative use of PGPR in combination with SA found to be an efficacious strategy to improve plant growth under stressed conditions particularly under water-deficient conditions (Khan and Zandi *et al.* 2018) .

Islam *et al.* (2016) noted that inoculation with selected PGPB and SA application either alone or in combination alleviated the chromium (Cr) toxicity and promoted plant growth by decreasing Cr accumulation, H₂O₂ and MDA level in maize. Furthermore, dual PGPB inoculation with SA application also improved plant performance under Cr-toxicity. Results obtained from this study indicate that PGPB inoculation and SA application enhanced Cr tolerance in maize seedlings by decreasing Cr uptake from root to shoot. Additionally, combination of both PGPB and SA also reduced oxidative stress by elevating the activities of enzymatic and non-enzymatic antioxidant, also indicated by improved carbohydrate metabolism in maize plant exposed to Cr contamination. The results suggest that combined use of PGPB and SA application may be exploited for improving production potential of maize in metal (Cr) contaminated soil .

Salicylic Acid and putrescine (Put's) complementary results with PGPR bioinoculants Via increased water and nutrient absorption, increased phosphorous supply, enhanced downregulation, and ROS scavenging, the effects of PGPRs and PGRs are mediated. The additional advantage of SA can be due to the development of SA mediated SAR that changes plant resistance to different stresses the SA supports PGPRs, while enhancing root defense against desiccation tension, improved Na/Ca ratio, and a decrease in lipid peroxidation and osmoregulation (Khan, Bano, and Babar 2019) .exogenous application of SA, Fe(II) and *Burkholderia* sp. D54 or their complex effectively reduced Cd accumulation. Among all treatments, (SA+Fe+B) exerted the best performance. but only SA

and *Burkholderia* sp. D54 treatment increased pigment contents and photosynthetic performance in Cd sensitive genotypes. All treatments significantly decreased Cd accumulation in both tomato genotypes (Wei *et al.* 2018) .

The use of bacterial induction, in addition to the ease of use, plays a major role in raising the production potential of the wheat crop, as the seeds can be quickly handled with bacteria before planting them. The use of bacterial induction decreases the cost of growing the seed by up to 50 percent of the recommended volume of fertilizer using low amounts of nitrogen fertilizer. In the germination process in the wheat plant, the influence of bacteria is significant since it increases the germination process by raising the number of bacteria across the root, and this results in an increase in yield. By fixing nitrogen and dissolving nutrients such as phosphorous, bacteria have also played a significant role in the growth process in the wheat plant. Oh, and packed. For the regulators of growth and plant (Jediaa *et al.* 2009) .

The application of salicylic acid, a hormone involved in plant signalling, plant stress may be minimized. The aggregation of mineral nutrients such as (K^+ , Ca^{+2} , P, N and Mg^{+2}) is observed by (Wani *et al.* . 2016) once the weapon protection in the plant against biotic stress. In the presence of NaCl, exogenous application of SA improved plant behavior. Nevertheless, in response to the combined (SA + Ca) treatment, the best results were obtained in terms of growth, photosynthetic pigment concentrations and mineral nutrition (limitation of Na^+ accumulation and conservation of K^+ and Ca^{2+} content). Although the physiological parameters involved differ depending on the cultivar considered, the findings indicate that in the presence of (NaCl, Ca^{+2} and SA) can combine to reduce the stress encountered by the plant. However, the inhibition of the absorption of potassium by oat roots

was dependent on the pH and the concentration of the element in the medium under the influence of SA. At lower pH, this inhibition was more pronounced, implying greater protonate salicylic acid type production (Harper and Balke, 1981; Gordon et al., 2002). Amongst the majority of influential P solubilizers bacterial strains from the genera *Pseudomonas*, *Bacillus*, *Rhizobium* and *Enterobacter* are of great importance. Application of phosphate solubilizing microbes in the production of compost can help to increase the interest of farmers to use organic phosphatic fertilizers in alkaline soils (Chen et al. 2006) .

2-5-3 : Effect of Salicylic Acid and *Pseudomonas fluorescens* in Protein and carbohydrates Content :

Rich in protein, carbohydrates, and minerals, bread wheat (*Triticum aestivum* L.) is one of the world's most important cereal grain crops, serving as the staple food source for 30% of the human population (Lobell, et al. 2011) .The major components of wheat grains that influence nutritional value and end-use consistency are carbohydrates, protein, amino acids, lipids and minerals. Among them, protein is a significant component that defines the consistency of bread making (Pomeranz 1987; Shewry 2009). Protein content ranges from 10-20 percent in fully matured wheat grain (Shewry et al . 1994) and usually from 10-15 percent in western Europe. It produced 66.3 x 10⁹ kg total protein and 9.4 kg protein / capita / annum (assuming 7 billion world population) in 2012 if we assume 10 percent protein content in wheat grain. (Balyan et al. 2013). Treatments with SA controlled metabolic processes and raised sucrose content, controlled the expression of sucrose metabolism genes, and enhanced the expression of two dehydration-responsive transcription factors (Zhao et al. 2021) .

P. fluorescens alone as well as in co-injunction with PGRs (such as SA) and co-treatment of all three PGPRs + 2 PGRs. The findings revealed that in combination with PGRs, PGPR alone or their consortium or PGPR consortium resulted in a larger increase in the sensitive variety in leaf protein concentration than in the resistant variety. In both treatments, the concentration of proline was lowered in untreated plants grown in sandy soil. The greatest decrease (51% and 39%) resulted from inoculation of plants with consortium of *P. fluorescens* in combination with PGRs followed by plants treated only with SA. The tolerant variety generally had higher proline concentration than the sensitive variety. SA was more effective in reducing the proline concentration of the sensitive variety (Khan, *et al.* 2019).

The adaptation of apoplastic proteins and antioxidant enzymes associated with cold stress tolerance, salicylic acid plays an essential role (Tasgin *et al.*, 2003). The increase or decrease in antioxidant activity can be due to decreases or changes in protein decomposition production (El-Tayeb, 2005). However, due to the application of salicylic acid in the rye, the accumulated protein did not play a role in the antifreeze operation (Yu, *et al.*, 2001).

Multiple reactions in plants are caused by varying amounts of salicylic acid and its successful cycle (Hare and Cress, 2004; and Senaratna *et al.*, 2003) and the role of salicylic acid in frost resistance is still uncertain and further study is needed. Potassium stimulates the enzyme responsible for starch synthesis (starch synthase). So, the level of starch declines when the amount of potassium is small, whereas soluble carbohydrates and nitrogen compounds accumulate, demonstrating that PGR (SA and Put) had no or little role on accumulation of leaf protein content when

applied in combination with PGPR. SA alone was more effective (23%) in sensitive variety than tolerant variety (Khan, *et al.*, 2020) .

The inoculation of cereal crops with plant growth-promoting bacteria (PGPB) is a potential strategy to improve fertilizer-N acquisition by crops in soils with low capacity to supply N. A study was conducted to assess the impact of three inoculants on grain yield, protein content, and urea-¹⁵ N recovery in maize (*Zea mays* L.) under Cerrado soil and climate conditions. Martins noted that the inoculation of maize grains with PGPB represents a strategy to improve fertilizer-N recovery and maize yield in Cerrado soil with a low capacity to supply N (Martins *et al.* 2018) .

It is questionable as to whether yield can be increased greatly without supplying more N, as N determines vegetative growth, e.g. canopy and therefore sets the potential for photosynthate production. In addition, storage organs would require N, and in cases where protein content is an essential quality attribute, optimised N supply is even more essential. However, when carbohydrate is the major component of yield, increased photosynthesis without an increased canopy biomass (and hence the requirement of N for canopy production), will enable an increase in yield without a concomitant increased crop N requirement. Ideally, N in the canopy will be either remobilised to the harvested organ as a useful protein or may be recycled as manure for future crop production (Parry and Hawkesford 2010) .

Leaf protein concentrations Combined treatment of *P. Chinense*, *B. cereus* and *P. fluorescens* showed maximum increase (43%) in leaf protein content of drought sensitive and tolerant varieties, respectively, as compared to untreated plants grown in sandy soil. Leaf protein content was also significantly higher in the

leaves of plants treated with *P. Chinense*, *B. cereus* and *P. fluorescens* and sprayed with SA and Put as compared to uninoculated control in both the varieties. *P. chinense* in combination with PGRs and coinoculation of *B. cereus* and *P. fluorescens* alone as well as in association with PGRs and the combined treatment of all three PGPRs + 2 PGRs resulted in a noticeable increase in leaf protein concentration for the sensitive variety. The results showed that PGPR alone or their consortium or PGPR consortium in association with PGRs, resulted in a greater increase in leaf protein concentration in the sensitive variety than in the tolerant variety (Khan, *et al.*, 2019). Khan showed that (Combined treatment of *B. subtilis*, *B. thuringiensis* and *B. megaterium*) had significantly (33% and 37%) enhanced the leaf protein content over uninoculated untreated plants grown in sandy soil, followed by (inculation with *Bacillus subtilis*) in both the varieties (Khan, *et al.*, 2020).

3- Materials and Methods

3-1: Materials :

3-1-1 : Apparatuses and instrument :

The table show Apparatuses and Equipment used in this study.

Table(3.1): Apparatus Used in the Experiment and their Companies and Origin

No.	Apparatuses and instrument	Company	Origin
1	Autoclave	Systec	Germany
2	Centrifuge	Universal	China
3	Digital Balance	Kern	Germany
4	Water Distiller	LabTech	Korea
5	Flam photometer	LabTech	korea
6	Hood	LabTech	Korea
7	Hot plate magnetic stirrer	LabTech	Korea
8	Light microscop with camera	genex	china
9	Kjeldahl system		
10	Water Bath	Lab Tech	Korea
11	Oven	Memmert	Germany
12	Electrical conductivity meter	Europe	Romania
13	Refrigerator	Concord	France
14	Specterophotometer	Chrom tech	Usa
15	Grinder	Silver crest	Germany
16	Shaker		China
17	Muffle furnace		Germany
19	Incubator	Memmert	Germany

Table (3.2): Equipment Used in the Experiment and their Companies and Origin

No.	Equipment	Company	Origin
1	Slides	Sail brand	China
2	Cover Slides	Sail brand	China
3	Disposable surgical Gloves	Royal	Malaysia
4	Funnel	Volac	England
5	Dust masks	Master guard	China
5	Motar and pestle	ISO lab	Germany
6	Filter paper	Zelpa	China
7	Volumetric flasks	ISO lab	Germany
8	Test tube	afco	Jordan
9	Timer	Junghans	Germany
10	Glass flasks and beakers	ISO lab	Germany
11	Parafilm	Rusco	U.K
12	Petri Dishes	QC lab	China
13	Graduated cylinder	Volac	England
14	Qauze wab	Hospital&homecara	China
15	Makarthy tube , flat bottom	Baracopharma	china

3-1-2 : Micrological media**3-1-2-1 : Micrological media**

Table (3.3): media Used in the Experiment and their company :

No.	media	Company
1	King B agar	
2	Brain Heart Infusion Agar	Himedia
3	Brain Heart Infusion Broth	Himedia
4	Potato Dextrose (PDA) Agar	Himedia
5	King A medium	
7	nutrient agar	Himedia
8	nutrient broth	Himedia

3-1-2-1-1 : Culture media preparation :**1:King-B Agar**

It was prepared by adding 20 g peptone, 10 ml glycerine , 1.5 g of potassium monohydrogen phosphate (K_2HPO_4) and 1.5 g aqueous magnesium sulfate $MgSO_4 \cdot 7H_2O$ to a liter of distilled water, then sterilized with an autoclave and used to detect the production of fluorescein pigment This medium is suitable for the bacteria *P. fluorescens* described by (Atlas et al., 1995) .

2-Brain Heart Infusion Broth

It was Suspend 37.0 grams in 1000 ml purified/distilled water. Dispense into bottles or tubes and sterilize by autoclaving at 15 lbs pressure (121°C) for 15 minutes. For best results, the medium should be used on the day it is prepared, otherwise, it should be boiled or steamed for a few minutes and then cooled before use . Final pH 7.4 ± 0.2 (at 25°C)(Atlas *et al.*, 1993) .

3-Brain Heart Infusion Agar

It was Suspend 53 grams in 1000 ml distilled water. Heat to boiling to dissolve the medium completely. Sterilize by autoclaving at 15 lbs pressure (121°C) for 15 minutes. It may be further enriched with addition of blood. For addition cool the medium at 45-50°C and aseptically add 5% v/v sterile defibrinated sheep blood. Mix well and pour into sterile Petri plates. Final pH (at 25°C) 7.4 ± 0.2 Formula adjusted, standardized to suit performance parameters(Atlas *et al.*, 1993) .

4-King A medium

It was prepared by adding 20 g peptone, 10 ml glycerin, 10 g anhydrous potassium sulfate K₂SO₄ and 1.4 g anhydrous magnesium chloride MgCl₂ to a liter of distilled water. The aforementioned materials were dissolved and the degree of reaction (pH) was adjusted to 7.2, then 20 g of the pH was added to it and heated for the purpose of dissolving the dens, then sterilized with an oxidizer and used this medium to detect the production of the pyocyanin pigment (Cowan, 1977).

5-Nutrient agar

It was Suspend (28.0 g) in (1000 ml) D.W.. Heat to boiling to melt the medium entirely. Autoclave to sterilize. Allow to cool to (50°C). Fill clean Petri plates halfway with the mixture (Marshall , 1992) .

6- Nutrient Broth (N.B.)

Dissolve (25 g) in (1L D.W.), If required, heat the medium to totally dissolve it.

Autoclave to sterilize (Greenberg *et al.*).

3-2 : Methods**3-2-1 : Soil samples collection :**

10 soil samples were collected from the rhizosphere for different plants and in different locations in samawa city and placed in sterile polyethylene bags and written on them all the information: location, date and cultivated plant, and preserved in the refrigerator to preserve the micro-organisms until the isolation process was carried out for each sample in case the isolation was not done directly After collecting the sample (Table 3.4), which shows the location of the samples collection and the plant grown for these sites.

Table (3.4) shows samples Soil collection used in this study :

Sample no.	Sampling site	Date of taking the sample	Cultivated plant	Soil isolation symbol
1	Samawah Gardens	8/11/2020	Mint	M1
2	Samawah Nurseries	8/11/2020	Rosa	S1
3	Samawah Nurseries	8/11/2020	Rosa	S2
4	Samawah Gardens	8/11/2020	Basil	B1
5	Almumalahuh	10/11/2020	Maize	Z3
6	Almumalahuh	10/11/2020	Clover	C2
7	Mahdi	14/11/2020	Maize	Z1
8	Mahdi	14/11/2020	Rice	R1
9	Mahdi	14/11/2020	Clover	C1
10	Mahdi	14/11/2020	Maize	Z2

3-2-2 :Isolation and Identification of bacteria (*pseudomonas fluorescens*)**3-2-2-1 : Isolation of bacteria (*pseudomonas fluorescens*) :**

Serial dilutions were prepared for each soil sample by adding 10 g of each soil sample to 90 ml of sterile distilled water in 250 ml flasks , Mixed well and performed a series of decimal dilutions (10^{-5} _ 10^{-6} _ 10^{-7}) by transferring (1 ml) of soil suspension to test tubes containing 9 ml of sterile distilled water and for each soil sample, use the medium (Brain Heart Infusion Broth).) To culture soil dilutions on it. Take 1 ml of dilution of soil prepared above for inoculation of test tubes containing (9 ml) of sterile medium above, Brain Heart Infusion Broth with a repeated effect for each dilution. The tubes were incubated at a temperature of 26 C° for a period of 2 days. Take 0.1 ml of the tubes that gave an indication of growth and spread them on the surface of a Petridish containing King B agar medium. The Petridishs were incubated at a temperature of 26 + 2 C° for a period of (2) days. The tubes were examined to notice the formation of a white thin film on the surface, which is a primary indicator of growth. *Pseudomonas fluorescens* subculturing the Petridishs to obtain pure colonies of bacteria. The colonies of yellow color were obtained, and on the one hand, in terms of their smell, they were isolated in a pure manner on solid environments, and symbols and numbers were given according to the area from which they were isolated (King, *et al.*1954).

3-2-2-2 Identification of bacteria (*pseudomonas fluorescens*) :

The purpose of obtaining pure colonies of *P. fluorescens*, a number of single colonies were selected that gave similar morphological characteristics to *P. fluorescens*. The streaking method was used for the purpose of subculturing these bacteria on the surface of a King B medium, using a loop carrier, and under sterile conditions, the dishes were incubated for a period of time (24-48) hours until colonies

that are far apart or close to each other appear, for the purpose of microscopic examination and biochemical tests (Holt *et al.* 1994).

3-2-2-2-3 : Morphological of properties :

- 1- According to the shape of the colony formed
- 2- According to the color shown on the colony
- 3- As well as according to the distinct smell that characterizes the bacteria (Holt *et al.* 1994) .

3-2-2-2-4 : Microscopic Examination :

One of the individual colonies was selected, spreading part of it on a glass slide in order to stain it in a Gram-stained method to identify the shape and assembly of cells and their interaction with a gram(Holt *et al.* 1994).

3-2-2-2-5 : cultural characteristics :

1: Growth at temperatures 4, 42 C° :

The bacterial isolates were seeded with (3) plates for each isolation on the medium of king B agar :

The first group : was incubated at a temperature of (4) C. for a period of 24 hours .

the second group : at a temperature of (42) C. For a period of (24) hours .

when the incubation period ended Whether there is growth or not. (Palleroni, 1984) .

2 : Fluorescence test for pigments :

The bacterial isolates were planted on solid king B medium, and the dishes were incubated at room temperature for a period of (24 hours), then the dishes were then examined the next day under an ultraviolet ray, and the positive result was inferred by the appearance of the growth fluorescence (Baron *et al.*, 1994).

3-2-2-2-6 : Biochemical tests :**1- Oxidase reagent :**

Prepared in accordance with the recipe (Atlas *et al*, 1995).Immediately, in sterile purified water, at a concentration of (1 %) Tetra methy - diaminedihydro chloride.

2- starch hydrolysis test:

In 300 ml of pure water, 1 g of iodine(I₂)and 2 g of potassium iodide(KI) were combined ,Starch agar :The medium was obtained by mixing 0.2 g of starch with 100 ml of nutrient agar, sterilizing it with an autoclave, and measuring the bacteria's ability to degrade the starch (Harrigan and McCance, 1976).

3- Nitrate reduction :

It was made by dissolving (1 g) of potassium nitrate in a liter of nutrient broth , distributing it in test tubes, sterilizing it with an autoclave, and using it to test bacteria's ability to reduce nitrate (Cowan, 1977).

4- Catalase test :

It is made up of hydrogen peroxide in a concentration of (3%) .

5- Indole test :

The indole ring identification test is made by (Kovacs reagent) : dissolving 5 g of (p-dimethyl amine benzaldehyde) in 75 ml of amyl alcohol (Isoamyl alcohol), then adding 25 ml of hydrochloride acid at a concentration of (37 %) (Harrigan and McCance, 1976).

6- Voges- Proskauer (VP):

Start preparing by dissolving 5 g -naphyl in 100 mL absolute ethyl alcohol and (40 g) potassium hydroxide in 100 mL (D.W.) in the second solution.

7- Gelatin test :

It was made by dissolving 12 g of gel in 100 ml of liquid nutrient medium , heating the medium to dissolve the gel, and sterilizing it with an autoclave. It was used to see whether bacteria could dissolve the gel (gelatin) and make it liquid even after it was refrigerated (Cowan, 1977).

8- Methyl red test :

It was made by dissolving 0.1 g of methyl red in 300 ml of (95 %) ethyl alcohol, then diluting it with 200 ml of D.W. (Harrigan and McCance, 1976).

9- Urease test :

Use medium Urea Agar to determine the ability of bacteria to degrade urea by producing the enzyme Urease.

10- Motility test :

Prepared by dissolving 4 g of agar powder in 20 g of liquid nutrient medium powder in 1 liter of purified water, sterilizing using an autoclave at , then placing the tubes vertically and using them to detect the movement of bacteria (Collee et al., 1996).

11- Kligler Iron Agar test (KIA test) :

It was used to test bacteria's ability to produce (H₂S) and the formation of a black iron sulfide precipitate (Baron and Finegold , 1990) .

3-3 : Maintenance and perpetuation of Bacteria isolation :

- 1- Maintenance for Short-term (week – 2 week) .
- 2- Maintenance for medium-term (one month) .
- 3- Maintenance for long-term (six month – 12 month) .

The isolates to be stored for a long time were inoculated in Makarthy tube containing (B. H. agar) with glycerol at a ratio of (5%) and after incubating the tubes with temperature (26) C⁰. for a period of (18) hours, they were kept in the freezer (-18) C⁰ (Karch *et al.*, 1995) .

3-4 : Preparing of experimental treatments .**3-4-1 : Preparing the bacterial inculation (*pseudomonas fluorescens*)**

Isolate Symbol (Z2) was chosen for its superiority in some growth criteria over the rest of the isolates. They were grown in solid King B medium in the incubator at 26 ° C for (48 h) , A swab was taken from pure king B agar colonies and inoculated into tubes containing 10 ml of the culture medium. Brain heart infusion broth (BHI) . And incubated for a day at a temperature of 26. Then, the bacterial suspension was taken and suspended with normal saline solution, then the dilution required for the inculation to be made. Three low, medium and high concentrations of *P. fluorescens* inoculum were obtained from the liquid culture (Broth) prepared from its (king B agar) solid culture: The number of cells in inoculation from low concentration *P. fluorescens* was (4×10^5) c.f.u./ ML ,The medium concentration (4×10^6) c.f.u. /ml .*P. fluorescens* ,The inoculum of high concentration *P. fluorescens* (4×10^7) c.f.u./ml .

As for the incubation temperature, it was 26 C° for a period of one day, before using a inoculum from *P. fluorescens* loaded to inoculate the shoots . Five plates containing solid (KB) medium were prepared and inoculated with bacterial suspension at a rate (0.1 ml) for each dish, incubated at a temperature of 26 + 1 C°.

for 48 hours, after which the number of colonies in each plate was calculated and the rate was extracted and multiplied by the reciprocal of the dilution (Clark, 1965) .After 10 days of sowing, she was treated with bacterial inoculum and calculated the concentrations that were determined from *P. fluorescens* and a volume of 10 ml / shoot in the (root bead) of the bacterial inoculation .

3-4-2 : Preparation of Salicylic Acid :

As a stock solution, 1gm of SA is dissolved in Liter distilled water to a concentration of 1000 ppm. Additionally, to minimize errors in chemical preparations, the titration rule :

$$C1 * V1 = C2 * V2$$

formula abbreviations :

- 1- C1 = concentration of stock solution .
- 2- V1 = volume that take from stock solution to prepare the studied concentrations .
- 3- C1 = the studied concentrations (0,50,100, and 150) ppm .
- 4- V2 = volume solution Preparation .

was used to prepare the studied concentrations (0,50,100, and 150) ppm, as well as distilled water stirrer, and then the amounts were put separately in a 1 liter flask for each procedure.(Chemiasof, 2011).

3-5 : Preparation of basic materials for the greenhouse experiment :

3-5-1 : preparation of wheat seeds :

In all experiments, wheat seeds were used, variety (Abaa 99) and variety (Abu-Ghraib), which were taken from Al-Najmi Research Station of the National Program

for Wheat Development in Iraq approved by the Ministry of Science and Technology. The germination process was performed on plates of 9 cm in diameter and the percentage of germination was (97% and 96%) respectively .

3.5.2 : Plant Cultivation :

This experiment was conducted under natural conditions in a Greenhouse of al Muthanna university /College of sciences by using two variety of plant seeds (*Triticum aestivum* L.)(Abaa 99) and (Abo–graib). Were putting in pots that weight (5 kg) in 3 replicates for each treatment.

■The plant cultivated as following :

1. sowing of wheat : sow (20) seeds at a depth of (2) cm, each of the two varieties, Abaa 99 and Abu- Gharib in (1/12/2020), and they used plastic pots (22 cm, a height of 19.4 cm and a capacity of 5 kg of soil) and a base diameter of 16.3 cm. After (15) days of sowing, the number of seedlings was reduced to eight seedlings / pot.
2. Irrigation of the pots : with 75% field capacity.
3. Age for plant around 18 days the plants were sprayed by SA + inoculated *pseudomonas fluorescens* . for two weeks at three stage leaves (Zadoks *et al.*1974).
4. The harvesting for some plants in after 60 days for physiological parameters and then the practical experimental was conducted.
5. The concentrations used in the experiment : Spraying the vegetative groups with four concentrations of salicylic acid (0, 50, 150,100) ppm, as well as injecting a region of the wheat roots bead with the following concentrations of P.

fluorescens with the concentration (4×10^5) c.f.u. /ml, and the concentration (4×10^6) c.f.u./ml *P. fluorescens* inoculum , and in inoculum of concentration *P. fluorescens* (4×10^7) c.f.u./ml and study the individual effect of each factor separately and the interaction between *P. fluorescens* and salicylic acid in some characteristics of vegetative growth, physiological characteristics, yield parameters .



Figure (3.3) :the wheat (*Triticum aestivum*) (Abo-graib)



Figure (3.4) : the wheat (*Triticum aestivum*) (Abaa 99)

3-5-3 : Soil Preparation :

To perform the study experiments, the soils was chosen from farms along the banks of the samawa river, Surface soil is collected from a depth of (0-30 cm) , dried using an antenna, and then passed through a (2 mm sieve) .In addition, a comprehensive chemical analysis of soil and agricultural equipment was conducted (table 3.6).

Table (3.6) : Some chemical and physical characteristics of the soil before sowing :

Field capacity	22.1 %	
HCO ₃ (meq/L)	2	
Phosphorous mg/kg	0.49	
Total nitrogen mg/kg	20.58	
Dissolved ions ppm	K ⁺	29.7
	Na ⁺	85.8
	Mg ⁺⁺	422
	Ca ⁺⁺	240
CL ⁻ (meq/L)	570	
(pH) Degree of soil reaction	6.3	
Electrical conductivity (E. C.) dS (/ cm)	0.4	
Organic matter (o.m)	% 1.1	
soil texture	Silty loam	
Soil mineral components	Clay	18%
	Silt	69%
	Sand	13%
Number of fungi and total <i>Pseudomonas</i> (CFU/gm)	Total Fungi (CFU/gm) X10 ⁴	0.3*10 ⁴
	Bacteria : <i>Pseudomonas</i> spp.	1.5*10 ⁴

3-6 : Sterilization :

These applied were implemented with the aim of preventing any pollution from occurring in the course of research by eliminating the unwanted microorganisms in their survival, as they were implemented according to the methods used in (Beck *et al.*, 1993).

3-6-1 : Sterilization of seeds :

The seeds used in the study were surface sterilized by washing the seeds with The tap water to remove the fogging substance, then they were transferred to a Clorox solution, which is a 4% sodium hypochlorite, and kept in it for three minutes, then the seeds were removed and washed with sterile distilled water 7 times. (Pikovskaya , 1948) .

3-6-2 : Sterilization of plastic pots :

Sterilize the inner surface of the pots by wiping it well with a piece of cotton impregnated with 95% ethyl alcohol, then remove the alcohol residue by washing the surface well with sterile distilled water.

3-6-3 :Sterilization of the air stream above the tables for dealing with bacterial cultures :

The bunsen burner torch or the alcohol lamp was kept burning during the entire work time on sterile tables or in the Laminar flow hood.

3-6-4 : Destroying neglected Bacterial culture :

Before neglecting these unwanted live cultures, they put them in an Autoclave and sterilized and destroyed.

3-7 : Watering of the plants :

The weights of the potted plants were recorded with the soil when its moisture was reached to the field capacity, in order to compensate for the loss of moisture in the irrigated soil when planting. After sowing, the pots were weighed daily in order to maintain the moisture level of each experimental unit at the field capacity of moisture and for the duration of the experiment, by watering it.

3-8 : Determination Soil Capacity Field :

The field capacity of the soil used for the tests was calculated by placing a filter paper at the bottom of a thin, perforated box and weighting it, then filling it with (100 g) of soil and immersing the bottom of the container in a water container for a period of time. On water, then taken out of the pot, and left until the very last drop of water was pulled away, and then weighed again (Craze, 1990) .

3.9 : Growth , Physiological Parameters**3-9-1 : Physiological Parameter :****3.9.1.1 : Leaf Relative Water Contents**

The relative water content of the plant leaves was estimated by cutting from the top of the plant the third completely expand leave in the afternoon since the plant had reached the true content of the water, weighing the leaf to calculate its fresh weight, and then rehydrating the leaves in distilled water for (12-16) h. at room temperature. The leaf cells at the top of their turgid pressure at that time. After oven drying the leaf samples at 70°C for 24 hours, the dry weight is calculated.

RWC is calculated from(Schonfeld *et al.*, 1988) formula as follows:

$$RWC = \frac{(FW - DW)}{(TW - DW)} * 100$$

formula abbreviations :

1- (FW)= fresh weight of a leaf

2- (DW) = dry weight of a leaf.

3- (TW)= turgid weight of leaf.

3.9.1.2 : Measurement of photosynthetic pigments Chlorophyll Type and Carotenoid Content .

The contents of chlorophyll and carotene in fresh leaves are measured using the procedure of (Mackinney .,1941) modifying by (Arnon., 1949) A mortar and pestle containing (80 %, 10ml) acetone was used to crush 200 mg of fresh tissue from inter venial leaf fields. Using a spectrophotometer, the optical density (OD) of the solution

was measured at 645, 663nm for chlorophyll determination and 452,5 nm for carotenoid measurement. (Chrom tech, USA).

To estimate the amount of chlorophyll, the following relationships were applied :

$$Chl.a = (12.7 (D663) - 2.69 (D645)) * \frac{V}{(1000 \times W)}$$

$$Chl.b = (22.9 (D645) - 4.68 (D663)) * \frac{V}{(1000 \times W)}$$

$$Chl.(a + b) = (Chl.a) + (Chl.b)$$

$$Carotenoids = 4.2 \times D452.5 - (0.0264 Chl.a + 0.426 Chl.b) * \frac{V}{(1000 \times W)}$$

formula abbreviations :

- 1- (D) = the optical density reads of chlorophyll extracted at the wavelengths 663 and 645 nm, respectively
- 2- (V)= The final volume of the diluted acetone is (80%).
- 3- (W)= weight per gram of extracted vegetable tissue.



Figure (3.1) : spectrophotometer

3.9.1.3 : Measurement Percentage of Membrane Stability

The membrane stability was determined by cutting uniform leaf discs from randomly selected plants per replicate and washing them with distilled water to eliminate surface contamination before transferring them to a petri dish containing 5 ml of distilled water. Keep the petri dishes at 10 °C for 24 hours, then test the conductivity in the solution using an electrical conductivity (EC) meter. The same samples putting in Makarthy tube and then putting it in autoclave at 121 °C for 20 minutes, then cooled to 25 °C, where (EC) of the left filter was re-measured and the proportion of the harm index was calculated using the formula of Sullivan (1971) modifying by (Bandurska , 1998) by way of follows :

$$MSI (\%) = \left(1 - \frac{T1}{T2} - 1 - \frac{c1}{c2} \right) * 100$$

formula abbreviations :

- 1- T_1 : Symbolize the readout of the treatment's (EC) before the tissue was damaged .
- 2- T_2 : Symbolize the readout of (EC) of treatment after the tissue was killed .
- 3- C_1 : represent conductivity measurements of control samples before autoclaving .
- 4- C_2 : represent conductivity measurements of control samples after autoclaving .

3.9.1.4 : Estimation of Permeability of Potassium (K^+) and (Na^+)

The concentration of sodium and potassium ions was also estimated for leachates foliar tissue by Flame Photometer , calculated using the formula of Sullivan (1971) modifying by (Bandurska , 1998).

3.9.1.5: Estimation of Total Soluble Protein

The folien procedure was used to calculate the protein. (Schacterale and Pollak,1973) method has been rehabilitated (Lowry *et al.*, 1951) Using an optical spectrometer, calculate the apparent density at 650 nm.

3.9.1.6 : Estimation of Carbohydrates

0.2 g well-grounded leaves mix with distilled water (10 ml), centrifuge for (15 min / 3000 rpm) , aspirate the solution with filter paper, then pull 1 ml of leachate into a new test tube . After stirring and turning, add 5 ml of phenol at 5% and 5 ml of 80 % sulfuric acid. After proper dilution over a 488 nm wavelength using a spectro photometer, the tubes are cooling and photo resisted. (Al Wahbi and Bassallah, 2003).

3.9.1.7 : Digestion of Plant Sample to Determine Mineral

Using the grinder , grind 0.5 grams of the dry plant sample. (Alzoubi, *et al.*, 2013) and digest the sample using the wet digestion process by adding 5 cm³ of sulfuric acid H₂SO₄ and HClO₄ in a 1:4 ratio and heating the sample on a hot plate it until solution color is visible, then filtration the sample prepared to measure the mineral as follows:

1- Determine the concentration of sodium, potassium and calcium in the plant
Sodium, potassium and calcium were measured in the plant using an optical flamephotometer as described by (Richard, 1954).



Figure (3.2) : Flame photometer

2- Estimation the concentration of nitrogen .

Nitrogen is estimated in the digested plant sample by Micro Kjeldahl as described by (Alzoubi, *et al.*, 2013).

3- Conclude the concentration of phosphor .

Phosphor concluded in the vegetative extract of the plant by spectrophotometer as described in (Richard, 1954).

4- Estimation Magnesium

Quantify the magnesium by Process Titration as described in (Richard, 1954).

3-9-2 : Growth Parameters :

Procedures for measurement include:

3.9.3.1 : Leaf Area

Take a fresh leaf from the highest of the stem and weigh it, then cut a disk (1 cm²) from the leaf and weigh it. The leaf area is calculated using the following formula:

(total leaf area = $1\text{cm}^2 \times \text{weight of leaf} / \text{weight of the disc}$), (Shaheen M.A, 1987).

3-9-2-2 : Plant heights :

The height of the plant's highest peak above the soil surface was measured by a tape measure.

3-9-2-3 : Measure the fresh weight and the dry weight of the plant :

The vegetative parts of the growing plants were cut in the potted randomly selected by scissors at age 60 days. Then the vegetative parts of each potted plant were placed in a paper bag and then weighed with the sensitive balance and the weight of the bag. To measure the dry weight of the plant, the vegetative parts of the cut plants and placed in their bags were dried in an electric oven for 70 c⁰ for a period of 48 hours until the weight was stable, and they were measured with a sensitive balance.

3-9-4 : yield Parameters :**3-9-4-1 :weight 100-Grain (g) :**

A total of 100 grain samples were weighed. The average, A total of replications were used in this study.

3.10 : Statistical analysis , Experimental Design and Treatments

The experiment was factorial based on a completely randomized design (CRD) with three replicates There were nine treatments for each (*Triticum aestivum* L.) cultivar plus the control one the treatment as follows (Khandan-mirkohi, Halbi and Salami, 2017, Antar and Alwakaa ,2010) :

Treatment	Concertation	Methods
T1 : (SA)	SA1 ,SA2 ,SA3=(50+100 and150) ppm	foliar shoot method
T2 : (PF)	PF1,PF2,PF3=Concentration <i>P. fluorescens</i> (4×10^5), (4×10^6), (4×10^7) c.f.u./ml	inoculation roots
T3 : (SA+PF)	different concentration that use in number T1 , T2	Combination between T1+T2 .

3-11 : Study design :

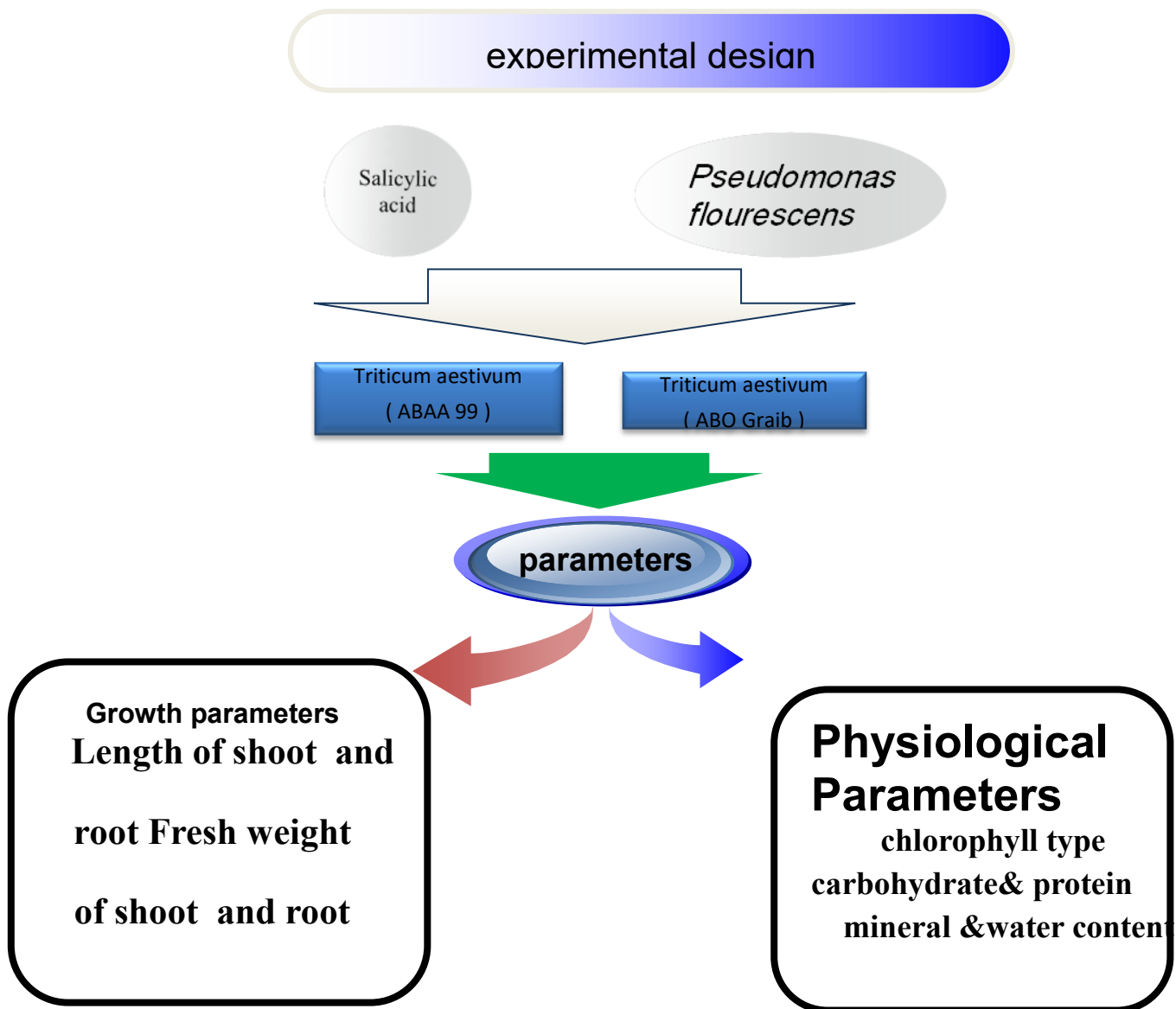


Figure (3.5): show experiment design

4-Results & Discussion :

4-1 The isolation of *Pseudomonas fluorescens* and identification:

The results of isolation and identification of *pseudomonas fluorescens* from 10 soil samples for the rhizosphere of different plants from different regions of Samawa showed the following :

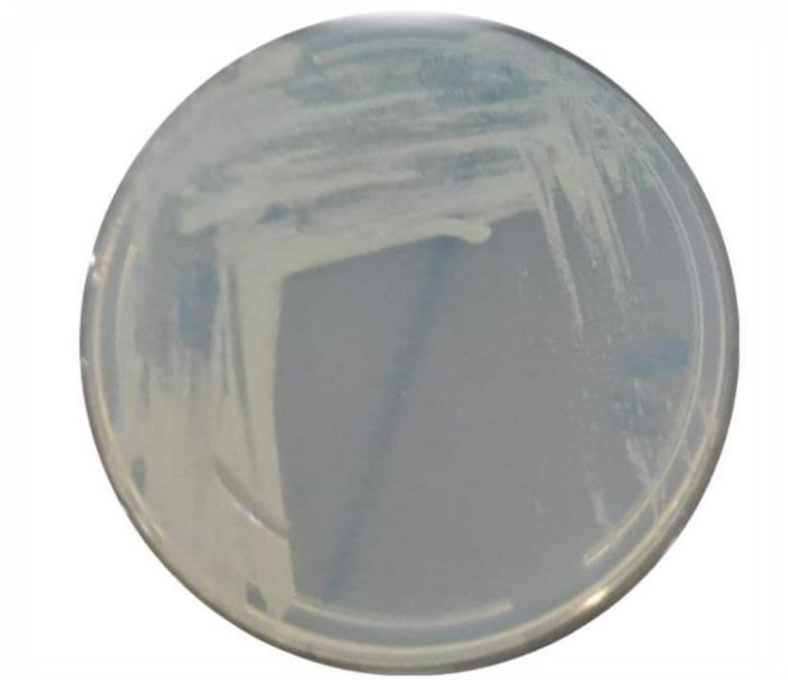
The results of culturing samples of different soils:(Maize, Rice,Clover,Mint, Basil, Rosa)showed :After carrying out the appropriate decimal mitigation, bacterial isolates were identified, which were culture in King B agar , the growth of 10 bacterial isolates, which were characterized by their cultural characteristics as having circular colonies, smooth surface, regular edges and with a distinctive smell, and these colonies showed their ability to fluoresce (yellowish green color) and their ability to move when stabbing the center of the cultural center, half solid, as it showed clear turbulence around the stab line. (Stolp and Gadkari, 1981) .

The biochemical diagnostic tests for *P. fluorescens* gave results, and these tests distinguish *P. fluorescens* from the rest of *Pseudomonas* ,Upon conducting differential tests that distinguish *P. fluorescens* from the rest of *Pseudomonas*, these isolates were able to grow at 4 ° C, and were not able to grow at 42 ° C. (Atlas, 1995)

The results of the microscopic examination of these bacterial colonies showed that their short rods cells were negative for gram stain and were sometimes found singly or in pairs. These results are in line with what was reported in (Holt *et al.* 1994).

The results of the biochemical tests of these bacterial isolates showed that they are positive for the tests for oxidase and catalase, while they varied in their ability to

liquefy gelatin, as most of the bacterial isolates gave a positive result for liquefying gelatin for this. The results of most of the isolates were negative for the nitrate reduction test and differed in the production of H₂S hydrogen sulfide, while most of them had the inability to produce the urease enzyme, while the isolates showed a negative result for the starch and indole degradation test and the red methyl test, while the citrate consumption varied, as most isolates gave a result negative ,Based on the results of the cultural and microscopic examinations and the biochemical tests, it has been shown that most of the bacterial isolates carry the characteristics of *pseudomonas fluorescens*. The isolation with symbol Z2 was chosen for its complete superiority , by the microscopic, cultural and biochemical tests of the total number of isolates and these results are consistent with what was mentioned by the inside of the study bacteria (Holt *et al.* 1994).



Figure(4.1): *pseudomonas fluorescens* colonies on king B agar

Table (4-1): the results of biochemical tests of bacterial isolates

biochemical tests	<i>pseudomonas fluorescens</i>
Motility test	+
Starch hydrolysis	-
Indole test	-
Catalase test	+
Oxidase test	+
Urease test	-
Gelatin test	-
H ₂ S production	-
Flourescent production	+
pyocyanin production	-
citrate consumption	+
Methyl red test	-
Voges- Proskauer	-
Nitrate reduction	-

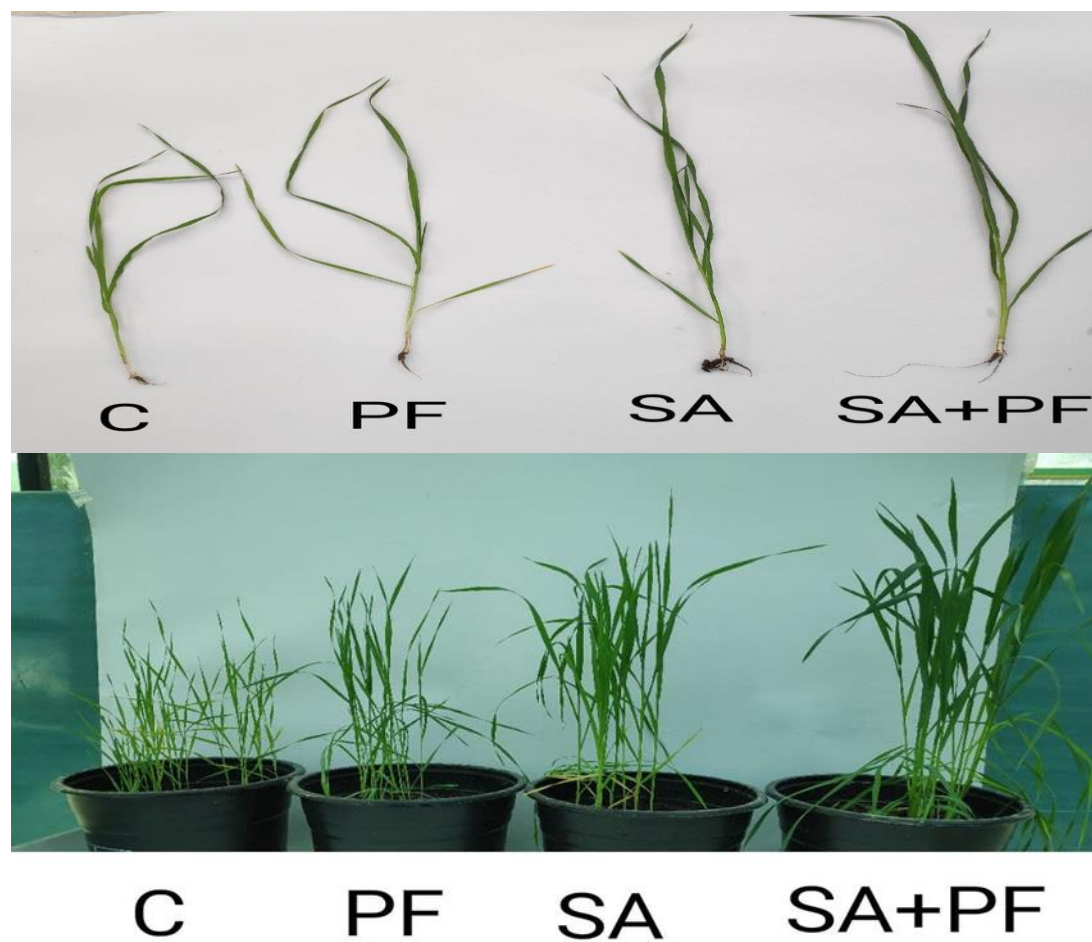
4-2 : Effect of *Pseudomonas fluorescens* and salicylic acid in Growth , Physiological Parameters .

4-2-1 : Effect of *Pseudomonas fluorescens* and salicylic acid in Growth Parameters :

4-2-1-1 : Effect of *Pseudomonas fluorescens* and salicylic acid in The Shoot Height of *Triticum aestivum* L.:

Pseudomonas fluorescens and salicylic acid effected on the Shoot Height in *Triticum aestivum* L. varieties (Abaa 99 , Abu-graib) can be seen in Table (4.2). The highest concentration is below the ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (64.50cm) and the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (63.23cm) for variety Abu-graib , they took same letters , compared with the control , And its ratio of (69.3%) .

In the other hand, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (60.33 cm) while the lowest value is at (36.76 cm) .On the other hand there are significant differences between other concentration at ($p \leq 0.05$) because they took the differences letters .



Figure(4.2): Effect of foliar of salicylic acid and *Pseudomonas fluorescens* inoculation on Shoot Height of wheat (*Triticum aestivum*) , Whereas :C= Control ,PF= inoculation *Pseudomonas fluorescens* ,SA= foliar of salicylic acid,SA+PF= Combination foliar of salicylic acid and inoculation *Pseudomonas fluorescens* .

the interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (56.68) cm, no significant differences between them at ($p \leq 0.05$) because they took the differences letters , for the second variety of wheat Abaa 99 , (53.60) cm ,they is no significant differences between them at ($p \leq 0.05$) because they took the same letters , and lower one at (37.49) cm .

Table (4.2) Effect of *Pseudomonas fluorescens* and salicylic acid in Shoot Height (cm) between the two varieties of *Triticum aestivum* .L.

Triticum aestivum .L	SA	Pseudomonas fluorescens				Interferen ce varieties × SA	Effect of varieties	Effect of SA		
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml					
Abaa 99	0	36.76 m	46.03 l	46.73 kl	45.46 l	43.75 d				
	50 ppm	49.46 kij	58.26 dbc	56.43 Dec	52.46 gihf	54.15				
	100 ppm	50.46 gihj	52.63 gihf	60.33 B	52.56 ghif	54.00 b				
	150 ppm	50.20 ihj	53.40 gehf	53.40 gehf	57.43 dbc	53.60 b				
Abu- graib	0	37.33 m	49.56 kij	49.33 Kij	48.33 klj	46.14 c				
	50 ppm	50.30 ihj	63.23 a	58.33 Dbc	53.60 gef	56.36 a				
	100 ppm	52.30 gih	56.30 dec	64.50 a	53.63 gef	56.68 gef				
	150 ppm	51.43 gihj	55.56 def	56.46 Dec	59.26 bc	55.68 a				
Interferenc e varieties × Pseudomon as fluorescens	Abaa 99	46.72 e	52.58 dc	54.22 b	51.98 d		51.37 b			
	Abu- graib	47.84 e	56.16 a	57.15 a	53.70 bc		53.71 a			
Interfere nce SA × Pseudom onas fluoresce ns	0	37.05 h	47.80 g	48.03 fg	46.90 g					44.94 c
	50 ppm	49.88 fe	60.75 a	57.38 b	53.03 dc					55.26 a
	100 ppm	51.38 de	54.46 c	62.41 a	53.10 dc			55.34 a		
	150 ppm	50.81 e	54.48 c	54.93 c	58.35 b			54.64 a		
Effect of Pseudomonas fluorescens		47.28 d	54.37 b	55.69 a	52.84 c					
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).										

As for the interaction between SA and *Pseudomonas fluorescens* were noticed that the SA2+PF2 has the highest values (62.41 cm) and SA1+FP1 (60.75) cm it was took same lettes , compared with other concentration , Followed by the value of SA3+PF3 (58.35) cm. The values gradually decrease from (57.38) cm, while the lowest value is (37.05) cm.

Actually, The effect of the (4 SA) concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (54.64) cm in a 150 pmm concentration , but no significant differences between them at ($p \leq 0.05$) because they took the same letters .

On the other hand ,the Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values(57.15 cm) in variety Abu-graib , but that the lowest value(46.72 cm) in Abaa 99 at the concentration at control .

Currently , the data of the Effect of varieties show higher value(53.71 cm) That's for variety Abu-graib and lower at (51.37 cm) That's for variety Abaa 99 .

At the latest on The results for the other variety that the highest values for *Pseudomonas fluorescens* it was (55.69 cm) in 10^6 cfu./ml and lower on(47.28 cm) .

4-2-1-2 : Effect of *Pseudomonas fluorescens* and salicylic acid in The root Length of *Triticum aestivum* L.:

Pseudomonas fluorescens and salicylic acid effected on the Shoot Height in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.3). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (53.06 cm) for variety Abu-graib , compared with the control , And its ratio of (62%) .

as a result, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (56.50 cm) while the lowest value is at(31.40 cm) .On the other hand there are significant differences between other concentration at ($p \leq 0.05$) because they took the differences letters.

Table (4.3) Effect of *Pseudomonas fluorescens* and salicylic acid in root Height (cm) between the two varieties of *Triticum aestivum* .L.

Varieties of <i>Triticum aestivum</i> L.								
Triticum aestivu .L m	SA	<i>Pseudomonas fluorescens</i>				Interfer- ence varieties × SA	Effect of varieties	Effect of SA
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
<i>Abaa</i> 99	0	31.40 n	41.00 m	42.76 Lkm	34.80 N	37.49 d		
	50 ppm	44.73 jil	54.26 dc	53.06 dec	43.33 jlk	48.85 b		
	100 ppm	45.06 jil	47.66 jik	56.50 bc	45.73 jil	48.74 b		
	150 ppm	43.26 jlk	48.66 jie	48.66 jie	55.03 dc	48.90 b		
<i>Abu- graib</i>	0	32.60 n	44.03 jil	43.96 jil	42.00 lm	40.65 c		
	50 ppm	45.33 jil	59.16 b	55.66 Dbc	49.00 ief	52.29 a		
	100 ppm	45.93 jilk	50.66 def	60.13 a	50.66 def	51.85A		
	150 ppm	47.33 jilkfgh	50.93 def	52.50 def	55.50 dbc	51.56 a		
Interferenc e varieties × <i>Pseudomo nas fluorescen s</i>	<i>Abaa</i> 99	41.11 g	47.90 d	50.25 bc	44.72 e		45.99 b	
	<i>Abu- Graib</i>	42.80 f	51.20 b	53.06 a	49.29 b		49.08 a	
Interferenc e SA × <i>Pseudomo nas fluorescen s</i>	0	32.00 i	42.51 g	43.36 hg	38.40 h			39.07 c
	50 ppm	45.03hg	56.71ba	54.36 c	46.16 f			52.57 a
	100 ppm	45.50 f	49.16 de	58.31 A	48.20 e			50.29b
	150 ppm	45.30 f	49.80 de	50.58 d	55.26 bc			50.23b
Effect of <i>Pseudomonas fluorescens</i>		41.95 c	49.55 a	51.65 a	47.00 b			
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).								

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).

the of interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (51.85 cm), but no significant differences between them at ($p \leq 0.05$) because they took the same letters , for the second variety of wheat Abaa 99 , (48.90 cm) ,they is no significant differences between them at ($p \leq 0.05$) because they took the same letters , and lower one at (31.40 cm) .

The interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the highest values (58.31 cm) , compared with other concentration , Followed by the value of SA1+PF1 (56.71 cm) . The values gradually decrease from (55.26 cm), while the lowest value is (32.00 cm) .

Actually, The effect of the (4 SA) concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (52.57cm) in a 50

pmm concentration , but significant differences between them at ($p \leq 0.05$) because they took the different letters .

On the other hand ,Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values(53.06 cm) in variety Abu-graib , but that the lowest value(41.11 cm) in Abaa 99 at the concentration at control ,in this point, the data of the Effect of varieties on root Height show higher value(49.08) cm That's for variety Abu-graib and lower at (45.99) cm That's for variety Abaa 99 ,at the final point . The results for that the highest values for *Pseudomonas fluorescens* it was (51.65) cm in 10^6 cfu.ml⁻¹ and lower on(41.95) cm .

Pseudomonas fluorescens and salicylic acid increased the shoot growth in different plant *Triticum aestivum* That is clearly from table (4.2) results which showed the effects of *Pseudomonas fluorescens* and salicylic acid concentrations in feature shoot length. for that reason the highest value at the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (64.50cm) and the low concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (63.23) cm for variety Abu-graib , was better, But at the other side,

Pseudomonas fluorescens and salicylic acid promote the shoot apex and meristematic tissues in that same area, increasing the length of the shoot. Wheat that has not been processed with *Pseudomonas fluorescens* and salicylic acid is higher as a result of many factors. and they are particularly in a different concentration of salicylic acid alone or *Pseudomonas fluorescens* alone . as they found in : (Azmat *et al.*, 2020,Dehghanian *et al.*, 2020,Khan , *et al* 2019) .

The function of SA in lowering the concentration of abscisic acid and suppressing the representation of ethylene, which caused plant ageing, including its effect by increasing carbon representation and photosynthesis and increasing the levels of hormones like cytokine and gibberellin, is the explanation for the plant's increased height as a result of its influence.(Prabha and kumar Negi, 2014).

PGPR such as *Pseudomonas fluorescens* greatly improved the growth and yield of different plant species (Farzana *et al.*, 2009). the inherent capacity to colonize the rhizosphere at a high density, interact effectively with other microbes, and generate secondary metabolites involved in plant growth stimulation, PGPR like *Pseudomonas* are of special interest. for the establishment of successful plant growth promoting and biocontrol strains, aggressive colonization and the ability to compete with resident microbes are needed. The effective inoculant should be able to thrive in the rhizosphere, use nutrients released by the plant, proliferate, colonize the whole root system effectively, and cope with endogenous microbes. Insufficient biocontrol in field trials be able to colonize the whole root system effectively when competing with endogenous microbes Inadequate biocontrol has been linked to low root colonization in field studies (Bloemberg and Lugtenberg 2001).

Rising the overall soil volume explored by the plant's root is one of the most effective ways to boost yield so the plants can absorb more water and nutrients., *Pseudomonas fluorescens* and salicylic acid has an effect on root time , As seen in the table(4.8) .demonstrates, observed from findings in combination between SA and *Pseudomonas fluorescens* particularly (SA2+PF2) , (SA1+PF1) give more optimistic , exactly what happen above (shoot length). shoot depends on the root for the water absorption and soluble ions as a first task, and the second to fixing of plant, to

resistance drought soil and salinity to look and keep plant safe as said (Jini and Joseph, 2017).

SA enhances cell division and plant development by preventing cytokinin and auxin degradation in plants. The function of SA in raising the size of leaves and the association of this acid (SA) with amino acids like tryptophan, which plays an important role in encouraging root growth and formation of AII, as well as its role in increasing the amount of cytokines that play major part in increasing root length and stimulating root growth, are the reasons for raising the total root length.(Sheneider and Whitman1974) .This is in line with sources that say *Pseudomonas fluorescens* increase shoot ,root length (Shanmugaiah *et al.*, 2019,Berta *et al.*, 2005) .This is in line with sources that say SA increase shoot ,root length (Larqu  Saavedra and Martin-Mex, 2007,Khodary, 2004) .

4-2-1-3 : Effect of *Pseudomonas fluorescens* and salicylic acid in the fresh shoot :

Pseudomonas fluorescens and salicylic acid effected on the fresh shoot in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.6). The highest concentration is below($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (4.55g) and low concentration *P. fluorescens* (10^5) c.f.u./ml (FP1) for a SA concentration of 50 ppm (SA1)), which was (4.48 g) for variety Abu-graib , they took same letters compared with the control .

In the other hand, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA

concentration of 100 ppm (SA2)), which was (4.05g) while the lowest value is at (0.76 g) .On the other hand there are significant differences between other concentration at ($p \leq 0.05$) because they took the differences letters .

Table (4.6) Effect of *Pseudomonas fluorescens* and salicylic acid in fresh shoot (g) between the two varieties of *Triticum aestivum* .L.

Triticum aestivum .L	SA	<i>Pseudomonas fluorescens</i>				Interference varieties × SA	Effect of varieties	Effect of SA
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
Abaa 99	0	0.76 r	1.22 p	1.45 o	1.16 qp	1.149 e		
	50 ppm	2.01 lm	3.57 c	3.20 d	2.55 i	2.835 c		
	100 ppm	2.11 lk	2.64 ih	4.05 b	2.54 i	2.835 c		
	150 ppm	2.06 l	2.70 gh	2.82 gf	3.51 c	2.775 c		
Abu-graib	0	1.04 Q	1.81 n	1.91 mn	1.43 o	1.550 d		
	50 ppm	2.13 lk	4.48 a	3.22 d	2.83 gf	3.167 a		
	100 ppm	2.33 j	2.92 ef	4.55 a	2.91 ef	3.182 a		
	150 ppm	2.23 Jk	3.02 e	3.19 d	3.44 c	2.971 b		
Interference varieties × <i>Pseudomonas fluorescens</i>	Abaa 99	1.737 h	2.535 e	2.880 c	2.441 f		2.398 a	
	Abu-graib	1.936 g	3.060 b	3.219 a	2.655 d		2.717 a	
Interference SA × <i>Pseudomonas fluorescens</i>	0	0.903 m	1.520 k	1.680 j	1.295 j			1.349 c
	50 ppm	2.071 i	4.028 b	3.210 d	2.695 g			3.001 a
	100 ppm	2.223 h	2.783 gh	4.301 a	2.728 g			3.009 a
	150 ppm	2.150 hi	2.861 f	3.008 e	3.475 c			2.873 b
Effect of <i>Pseudomonas fluorescens</i>		1.837 d	2.798 b	3.050 a	2.548 c			

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test ($P < 0.05$).

The interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm ,50 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (3.182g),(3.167 g) respectively they both took same letters ,While the values decreased significantly at the concentration of (150 ppm), for the second variety of wheat Abaa 99 ,they is significant differences between them at ($p \leq 0.05$) because they took the differences letters , and lower one at (1.149g) .

As for the interaction between SA and *Pseudomonas fluorescens* were noticed that the SA2+PF2 has the highest values (4.301g) compared with other concentration ,

Followed by the value of SA1+PF1 (4.028g) . The values gradually decrease from (3.475g), while the lowest value is (0.903 g) .

Actually, The effect of the (4 SA) concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (3.009 g) , (3.001 g) in a 100 ppm, 50 ppm concentration respectively .

On the other hand , Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values (3.219g) in variety Abu-graib , but that the lowest value (1.737g) in Abaa 99 at the concentration at control .

In this case, the data of the Effect of varieties show higher value (2.717 g) That's for variety Abu-graib and lower at (2.398 g) That's for variety Abaa 99 . there are no significant differences between varieties at ($p \leq 0.05$) because they took the same letters .

At the final point , The results for the other variety that the highest values for *Pseudomonas fluorescens* it was (3.050 g) in 10^6 cfu.ml⁻¹ and lower on (1.837 g) .

4-2-1-4 : Effect of *Pseudomonas fluorescens* and salicylic acid in the fresh root :

Pseudomonas fluorescens and salicylic acid effected on the fresh root in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.7). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (1.20 g) for variety Abu-graib , compared with the control .In the other hand, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P.*

fluorescens (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (0.93g) while the lowest value is at (0.43g) .On the other hand there are significant differences between other concentration at ($p \leq 0.05$) because they took the differences letters .

Table (4.7) Effect of *Pseudomonas fluorescens* and salicylic acid in fresh root (g) between the two varieties of *Triticum aestivum* .L.

Triticum aestivum .L	SA	<i>Pseudomonas fluorescens</i>				Interfere nce varieties × SA	Effect of varietie s	Effect of SA
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
<i>Abaa</i> 99	0	0.43 t	0.57 qr	0.59 q	0.53 rs	0.530 f		
	50 ppm	0.67 Monkl	0.89 dc	0.84 de	0.74 hig	0.786 c		
	100 ppm	0.65 Monp	0.74 hig	0.93 bc	0.70 mjkl	0.756 d		
	150 ppm	0.66 Monpl	0.72 hjik	0.73 hij	0.87 d	0.746 d		
<i>Abu- graib</i>	0	0.48 S	0.61 qp	0.64 onp	0.62 qop	0.591 e		
	50 ppm	0.68 Mjnkl	1.15 a	0.84 de	0.75 hfig	0.858 a		
	100 ppm	0.71 Hijkl	0.79 fg	1.20 a	0.76 hfg	0.866 a		
	150 ppm	0.72 Hijk	0.80 fe	0.85 d	0.95 b	0.833 b		
Interference varieties × <i>Pseudomona</i> <i>s fluorescens</i>	<i>Abaa</i> 99	0.603 f	0.732 d	0.774 c	0.710 d		0.705 b	
	<i>Abu- graib</i>	0.650 e	0.840 b	0.887 a	0.770 c		0.787 a	
Interferen ce SA × <i>Pseudomo</i> <i>nas fluorescen</i> <i>s</i>	0	0.456 j	0.594 hi	0.618 h	0.575 i			0.561 c
	50 ppm	0.678 g	1.023 b	0.843 d	0.745 f			0.822 a
	100 ppm	0.680 g	0.766 f	1.066 a	0.733 f	0.811 a		
	150 ppm	0.693 g	0.761 fe	0.795 e	0.910 c	0.790 b		
Effect of <i>Pseudomonas fluorescens</i>		0.627 d	0.786 b	0.830 a	0.740 c			
* Mean values followed by the same letter are not significantly different according to Duncan’s multiple range test (P < 0.05).								

The interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm ,50 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (0.866 g),(0.858 g) respectively they both took same letters ,While the values decreased significantly at the concentration of (150 ppm), for the second variety of wheat Abaa 99 ,they is significant differences between them at ($p \leq 0.05$) because they took the differences letters , and lower one at (0.530g) .

As for the interaction between SA and *Pseudomonas fluorescens* were noticed that the SA2+PF2 has the highest values (1.066 g) compared with other concentration, Followed by the value of SA1+PF1 (4.028g). The values gradually decrease from (1.023g), while the lowest value is (0.456g).

Actually, The effect of the (4 SA) concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (0.822 g), (0.811 g) in a 50 ppm, 100 ppm concentration respectively.

On the other hand, Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values (0.887g) in variety Abu-graib, but that the lowest value (0.603 g) in Abaa 99 at the concentration at control.

So the data of the Effect of varieties show higher value (0.787 g) That's for variety Abu-graib and lower at (0.705g) That's for variety Abaa 99.

At the latest on The results for the other variety that the highest values for *Pseudomonas fluorescens* it was (0.830g) in 10^6 cfu./ml and lower on (0.786 g).

Bacteria that colonize plant roots vigorously and support the plant by promoting growth. The early inoculation of crop plants with certain strains of PGPR increases biomass production through direct effects on root and shoot growth. Due to its diverse modes of action, *Pseudomonas fluorescens* is a gram-negative PGPR with a broad range of applications (Sruthi *et al*, 2013). The fresh weights of both shoots and roots for *Triticum aestivum* indicate that there are variations in weights, despite major and actual numerical differences between plants handled with *Pseudomonas fluorescens* and salicylic acid, as seen in tables (4.6) and (4.7). that the best concentration for *Pseudomonas fluorescens* and SA at (SA2+PF2), and the values (4.55, 1.20)g for both

fresh weight of shoot and root respectively, clearly at combination of SA and *Pseudomonas fluorescens* especially (SA2+PF2) took best values, followed by single application by SA, while *Pseudomonas fluorescens*, took 's final values for twice part of a plant , In the contrast of wheat plant varieties, the variety Abu-graib excelled at the detriment of the variety Abaa 99. As a result, these results were predicted, since increasing plant biomass and root duration for all plants and in all concentrations, as seen in tables (4.6) and (4.7), are compatible with the findings of (Bakundi and Yahaya, 2017) that the effect of different concentrations of combination *Pseudomonas fluorescens* and salicylic acid or sole increased the fresh weights of leaves plant and roots This is in line with sources that say *Pseudomonas fluorescens* increase shoot ,root length (Shanmugaiah *et al.*, 2019) , (Berta *et al.*, 2005) .(Jaleel *et al.*, 2007) This is in line with sources that say SA increase shoot ,root length (Larqu  -Saavedra and Martin-Mex, 2007) , (Khodary, 2004) , (Azmat *et al.*, 2020) .

4-2-1-5 : Effect of *Pseudomonas fluorescens* and salicylic acid in the

Dry shoot :

Pseudomonas fluorescens and salicylic acid effected on the dry shoot in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.4). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (1.239g) for variety Abu-graib , compared with the control . In the other hand, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (1.205g) while the lowest value is at (0.232g) .On the other hand there are

significant differences between them at ($p \leq 0.05$) because they took the differences letters .

Table (4.4) Effect of *Pseudomonas fluorescens* and salicylic acid in Dry shoot between the two varieties of *Triticum aestivum* .L.

Triticum .L aestivum	SA	Pseudomonas fluorescens				Interferenc e varieties × SA	Effect of varietie s	Effect of SA
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
Abaa 99	0	0.232 t	0.416 r	0.468 q	0.336 s	0.363 e		
	50 ppm	0.548 op	1.077 d	0.969 e	0.732 ij	0.831 c		
	100 ppm	0.632 n	0.750 i	1.205 b	0.698 kl	0.821 c		
	150 ppm	0.638 mn	0.811 h	0.806 h	1.052 d	0.827 c		
Abu- graib	0	0.320 s	0.545 op	0.562 o	0.525 p	0.488 d		
	50 ppm	0.669 ml	1.218 a	0.978 e	0.820 h	0.921 a		
	100 ppm	0.706 ki	0.856 g	1.239 a	0.835 gh	0.909 ba		
	150 ppm	0.641 mn	0.913 f	0.912 f	1.121 c	0.896 b		
Interference varieties × Pseudomona s fluorescens	Abaa 99	0.512 h	0.764 e	0.862 c	0.704 f		0.710 b	
	Abu- graib	0.584 g	0.883 b	0.923 a	0.825 d		0.804 a	
Interference SA × Pseudomona s fluorescens	0	0.276 n	0.480 l	0.515 k	0.431 m			0.425 a
	50 ppm	0.608 j	1.147 b	0.973 d	0.776 g			0.876 a
	100 ppm	0.669 h	0.803 f	1.222 a	0.766 g			0.865 ab
	150 ppm	0.639 i	0.862 e	0.859 e	1.086 c			0.861 b
Effect of Pseudomonas fluorescens		0.548 d	0.823 b	0.892 a	0.765 c			
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).								

The interference between varieties and concentrations of salicylic acid showed that the concentration 50 ppm ,100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (0.921 g),(0.909 g) respectively they both took same letters ,While the values decreased significantly at the concentration of (150 ppm), for the second variety of wheat Abaa 99 , no significant differences between them at ($p \leq 0.05$) because they took the same letters , and lower one at (0.363 g) . As for the interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the highest values (1.222 g) compared with other concentration , Followed by the value of SA1+PF1 (1.147) . The values gradually decrease from (1.086 g), while the lowest value is (0.276 g) .

Actually, The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (0.876 g) in a 50 ppm concentration. On the other hand, Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu.ml⁻¹ they have the highest values (0.923 g) in variety Abu-graib, but that the lowest value (0.512 g) in Abaa 99 at the concentration at control, so the data of the Effect of varieties show higher value (0.804 g) That's for variety Abu-graib and lower at (0.710 g) That's for variety Abaa 99. Eventually, The results for the other variety that the highest values for *Pseudomonas fluorescens* it was (0.892 g) in 10^6 cfu./ml and lower on (0.548 g).

4-2-1-6 : Effect of *Pseudomonas fluorescens* and salicylic acid in the Dry Root :

Pseudomonas fluorescens and salicylic acid effected on the dry Root in *Triticum aestivum* .L varieties (Abaa 99, Abu-graib) can be seen in Table (4.5). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2), which was (0.610g) for variety Abu-graib, compared with the control. In the other hand, there are substantial no variations between them at ($p \leq 0.05$), and they use same letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2), which was (0.580g) while the lowest value is at (0.126g). On the other hand there are significant differences between other concentration at ($p \leq 0.05$) because they took the differences letters.

Table (4.5) Effect of *Pseudomonas fluorescens* and salicylic acid in Dry Root (g) between the two varieties of *Triticum aestivum* .L.

Triticum aestivum Lm	SA	Pseudomonas fluorescens				Interference varieties × SA	Effect of varieties	Effect of SA				
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml							
Abaa 99	0	0.126 jkhi	0.173 jgheif	0.103 jk	0.055 k	0.114 e						
	50 ppm	0.130 jgkhi	0.410 b	0.325 c	0.213 gfe	0.269 c						
	100 ppm	0.156 jghfei	0.215 gfe	0.580 a	0.206 gfhe	0.289 bc						
	150 ppm	0.143 jghfi	0.210 gfeh	0.205 gfhe	0.370 bc	0.232 d						
Abu-graib	0	0.055 k	0.110 jk	0.116 jk	0.110 kj	0.097 e						
	50 ppm	0.183 jgfhei	0.576 a	0.363 bc	0.228 fe	0.337 a						
	100 ppm	0.196 gfhei	0.241 de	0.610 a	0.311 dc	0.339 a						
	150 ppm	0.183 jghfei	0.320 c	0.328 c	0.433 b	0.316 ab						
Interference varieties × Pseudomonas fluorescens	Abaa 99	0.139 f	0.252 d	0.303 bc	0.211 e				0.226 b			
	Abu-graib	0.153 f	0.312 b	0.354 a	0.270 dc				0.272 a			
Interference SA × Pseudomonas fluorescens	0	0.089 ji	0.141 hgi	0.110 hji	0.082 j							0.105 c
	50 ppm	0.156 hg	0.493 b	0.344 d	0.220 fe							0.303 a
	100 ppm	0.176 fg	0.228 fe	0.595 a	0.259 e	0.314 a						
	150 ppm	0.163 hg	0.265 e	0.266 e	0.401 c	0.274 b						
Effect of Pseudomonas fluorescens		0.146 d	0.282 b	0.329 a	0.241 c							
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).												

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test ($P < 0.05$).

the of interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm ,50 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (0.339 ,0.337) g respectively they both took same letters ,While the values decreased significantly at the concentration of (150 ppm), for the second variety of wheat Abaa 99 ,they is significant differences between them at ($p \leq 0.05$) because they took the differences letters , and lower one at (0.114g) .

As for the interaction between SA and *Pseudomonas fluorescens* were noticed that the SA2+PF2 has the highest values (0.595 g) compared with other concentration , Followed by the value of SA1+PF1 (0.493 g) . The values gradually decrease from (0.401 g), while the lowest value is (0.089 g) .

Actually, The effect of the (4 SA) concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (0.314 g) , (0.303 g) in a 100 ppm, 50 ppm concentration respectively .

On the other hand , Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values (0.354g) in variety Abu-graib , but that the lowest value (0.139 g) in Abaa 99 at the concentration at control .

In this point, the data of the Effect of varieties show higher value (0.272 g) That's for variety Abu-graib and lower at (0.272 g) That's for variety Abaa 99 .

At the final point The results for the other variety that the highest values for *Pseudomonas fluorescens* it was (0.329g) in 10^6 cfu./ml and lower on (0.282g) .

However, according our findings, exogenous application of *Pseudomonas fluorescens* and SA can improve dry shoot and dry root, especially when combined. This is consistent with the findings of (Shanmugaiah *et al.*, 2019) , (Berta *et al.*, 2005) .(Jaleel *et al.*, 2007) Where he found the effect of *Pseudomonas fluorescens* increases the dry shoot and dry root (Larqué-Saavedra and Martin-Mex, 2007) , (Khodary, 2004) , (Azmat *et al.*, 2020) Where he found the effect of SA increases the dry shoot and dry root .

4-2-1-7 : Effect of *Pseudomonas fluorescens* and salicylic acid in the Leaf Area:

Pseudomonas fluorescens and salicylic acid effected on the Leaf Area in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.8). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml

(FP2) for a SA concentration of 100 ppm (SA2)), which was (26.42) cm² for variety Abu-graib , compared with the control .

In the other hand, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (21.62) cm² while the lowest value is at (4.100) cm² .On the other hand there are significant differences between them at ($p \leq 0.05$) because they took the differences letters .

Table (4.8) Effect of *Pseudomonas fluorescens* and salicylic acid in Leaf Area between the two varieties of *Triticum aestivum* .L.

varieties of <i>Triticum aestivum</i> L.									
Triticum .L aestivum	SA	<i>Pseudomonas fluorescens</i>				Interference varieties × SA	Effect of varieties	Effect of SA	
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml				
<i>Abaa</i> 99	0	4.100 u	8.523 s	8.593 s	5.571 t	6.697 g			
	50 ppm	10.71 q	18.21 e	16.42 g	12.18 m	14.38 d			
	100 ppm	11.07 o	12.62 l	21.62 c	12.17 m	14.37 d			
	150 ppm	10.80 qp	12.87 l	13.36 k	18.31 e	13.83 e			
<i>Abu- graib</i>	0	4.215 u	9.51 r	9.427 r	9.314 r	8.118 f			
	50 ppm	11.21 o	23.45 b	17.31 f	14.22 j	16.55 b			
	100 ppm	11.77 n	15.10 i	26.42 a	14.86 i	17.04 a			
	150 ppm	11.52 n	15.62 h	16.62 g	18.65 d	15.60 c			
Interference varieties × <i>Pseudomonas fluorescens</i>	<i>Abaa</i> 99	9.172 h	13.05 e	15.00 c	12.05 f		12.32 b		
	<i>Abu- graib</i>	9.682 g	15.92 b	17.44 a	14.26 d		14.32 a		
Interference SA × <i>Pseudomona s fluorescens</i>	0	4.158 n	9.019 l	9.010 l	7.443 m				7.407 d
	50 ppm	10.96 k	20.83 b	16.87 d	13.20 i				15.46 b
	100 ppm	11.42 j	13.86 g	24.02 a	13.52 h				15.70 a
	150 ppm	11.16 k	14.24 f	14.99 e	18.48 c				14.72 c
Effect of <i>Pseudomonas fluorescens</i>		9.427 d	14.49 b	16.22 a	13.16 c				
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).									

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test ($P < 0.05$).

the of interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (17.04) cm², While the values decreased significantly at the concentration of (50 and 150) ppm, respectively for the second variety of wheat Abaa 99 , the highest value is 50 ppm,100 ppm (14.38) cm² ,(14.37) cm² and lower one at (6.697) cm².

As for the interaction between SA and *Pseudomonas fluorescens* were noticed that the SA2+PF2 has the highest values (24.02) cm² compared with other concentration , Followed by the value of SA1+PF1 (20.83) cm² . The values gradually decrease from 18.48cm², while the lowest value is (4.158) cm².

Actually, The effect of the four SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (15.70) cm² in a 100 ppm concentration. On the other hand , Interference varieties and *Pseudomonas fluorescens* indicate a 10⁶ cfu./ml they have the highest values (17.44) cm² in variety Abu-graib , but that the lowest value (9.172) cm² in Abaa 99 at the concentration at control .

Here, the data of the Effect of varieties show higher value (14.32) cm² That's for variety Abu-graib and lower at (12.32) cm² That's for variety Abaa 99 . At the latest on The results for the other variety that the highest values for *Pseudomonas fluorescens* it was (16.22) cm² in 10⁶ cfu.ml⁻¹ and lower on (9.427) cm².

However, according to findings, exogenous application of *Pseudomonas fluorescens* and SA can improve leaf area , especially when combined. This is consistent with the findings of both (Naserzadeh *et al.*, 2018) Where the effect of bacteria increases was found in the leaf area and the number of leaves and (Larqu   Saavedra and Martin-Mex, 2007) Where the effect of SA increases was found in the leaf area and the number of leaves .

4-2-2 : Effect of *Pseudomonas fluorescens* and salicylic acid in**Physiological Parameters :****4-2-2-1 : Effect of *Pseudomonas fluorescens* and salicylic acid in the****Chlorophyll a Content :**

Pseudomonas fluorescens and salicylic acid effected on the content of chlorophyll a in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.9). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (2.832) mg/g for variety Abu-graib And its ratio of 31.6% compared with the control .In the other hand, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (2.634) mg / g while the lowest value is at FP2+SA2 it was (0.84) mg/g .On the other hand there are significant differences between them at ($p \leq 0.05$) because they took the differences letters .

Table (4.9) Effect of *Pseudomonas fluorescens* and salicylic acid in chl.a between the two varieties of *Triticum aestivum* L.

Triticum .L aestivum	SA	Pseudomonas fluorescens				Interferenc e varieties × SA	Effect of varietie s	Effect of SA			
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml						
Abaa 99	0	2.113 t	2.162 r	2.176 q	2.145 s	2.149 h					
	50 ppm	2.252 o	2.532 d	2.425 ef	2.329 k	2.384 e					
	100 ppm	2.273 n	2.345 j	2.634 c	2.332 k	2.396 d					
	150 ppm	2.261 o	2.351 ji	2.365 h	2.534 d	2.378 F					
Abu- graib	0	2.143 s	2.202 p	2.202 p	2.182 q	2.182 g					
	50 ppm	2.283 n	2.735 b	2.432 e	2.364 hi	2.453 B					
	100 ppm	2.315 l	2.383 g	2.832 a	2.361 hi	2.473 A					
	150 ppm	2.302 m	2.393 g	2.416 f	2.530 d	2.410 C					
Interference varieties × Pseudomona s fluorescens	Abaa 99	2.225 h	2.348 e	2.400 c	2.335 f		2.327 b				
	Abu- Graib	2.261 g	2.428 B	2.470 a	2.359 d		2.380 a				
Interferenc e SA × Pseudomon as fluorescens	0	2.128 n	2.182 l	2.189 l	2.164 m						2.166 d
	50 ppm	2.268 k	2.633 b	2.428 d	2.346 h						2.419 b
	100 ppm	2.294 i	2.364 g	2.733 a	2.364 h				2.434 a		
	150 ppm	2.282 j	2.372 f	2.390 e	2.532 c				2.394 C		
Effect of Pseudomonas fluorescens		2.243 d	2.388 b	2.435 a	2.3475 c						
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).											

The first part the of interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (2.473) mg/g, While the values decreased significantly at the concentration of (50 and 150) ppm, respectively for the second variety of wheat Abaa 99 , the highest value is 100 ppm (2.396)) mg /g, and lower one at (2.149) mg /g .

As for the interaction between SA and *Pseudomonas fluorescens* were noticed that the SA2+PF2 has the highest values (2.733) mg/g compared with other concentration , Followed by the value of SA1+PF1 (2.633) mg /g . The values gradually decrease from 2.390 mg /g , while the lowest value is (2.128) mg/g.

Actually, The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (2.434) mg/g in a 100 ppm concentration. On the other hand , Interference varieties and *Pseudomonas*

fluorescens indicate a 10^6 cfu./ml they have the highest values(2.470) in variety Abu-graib , but that the lowest value(2.225) mg /g in Abaa 99 at the concentration at control .

Here, the data of the effect of varieties show higher value(2.380) mg /g That's for variety Abu-graib and lower at (2.327) mg /g That's for variety Abaa 99 . At the latest on The results for the other variety that the highest values for *Pseudomonas fluorescens* it was (2.435) mg / g wet weight in 10^6 cfu.ml⁻¹ and lower on(2.243) mg/g.

4-2-2-2 : Effect of *Pseudomonas fluorescens* and salicylic acid in the Chlorophyll b Content :

The results indicated in the table (4.10) showed the effect of *Pseudomonas fluorescens* and salicylic acid on chlorophyll b of the *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib). varieties there are significant differences with different concentrations with *Pseudomonas fluorescens* and salicylic acid of chlorophyll b content the highest value at *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (0.963) mg/g for variety Abu-graib. and the lowest value for the same variety it was (0.612) mg/g And its ratio of (57.3%) compared with the control.

Table (4.10) Effect of *Pseudomonas fluorescens* and salicylic acid in chl.b between the two varieties of *Triticum aestivum* .L.

Triticum aestivum .L	SA	Pseudomonas fluorescens				Interferenc evarieties × SA	Effect of varietie s	Effect of SA	
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml				
Abaa 99	0	0.612 p	0.613 p	0.615 p	0.612 p	0.613 d			
	50 ppm	0.607 p	0.870 e	0.836 fg	0.711 m	0.7565 b			
	100 ppm	0.630 o	0.743 k	0.926 c	0.727 l	0.7569 b			
	150 ppm	0.616 op	0.754 jk	0.758 j	0.843 f	0.743 C			
Abu- graib	0	0.612 p	0.617 op	0.617op	0.616op	0.615 D			
	50 ppm	0.676 n	0.940 b	0.850 f	0.773 i	0.810 A			
	100 ppm	0.704 m	0.803 h	0.963 a	0.783 i	0.813 A			
	150 ppm	0.701 m	0.813 h	0.826 g	0.903 d	0.811 A			
Interference varieties × Pseudomon as fluorescens	Abaa 99	0.616 h	0.745 e	0.784 c	0.723 f		0.717b		
	Abu- Graib	0.673 g	0.793 b	0.814 a	0.769 d		0.762a		
Interferen ce SA × Pseudom onas fluoresce ns	0	0.612 k	0.615 k	0.616 k	0.614 k				0.614 c
	50 ppm	0.6421 j	0.905 b	0.843d	0.742 h				0.783A
	100 ppm	0.667 i	0.773 F	0.945 a	0.755 g				0.785 A
	150 ppm	0.659 i	0.784 e	0.792 e	0.873 c				0.777 b
Effect of Pseudomonas fluorescens		0.645 d	0.769 b	0.799 a	0.746 c				
* Mean values followed by the same letter are not significantly different according to Duncan’s multiple range test (P < 0.05).									

the result of interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (0.813) mg/g, While the values decreased significantly at the concentration of (50 and 150) ppm, respectively for the second variety of wheat Abaa 99 , the highest value is 100 ppm (0.7569) mg /g, and lower one at (0.613) mg /g .

The interaction between SA and *Pseudomonas fluorescens* were found that the SA2+PF2 has the highest values (0.945) mg/g compared with other concentration , Followed by the value of SA1+PF1 (0.905) mg /g . The values gradually decrease from 0.873mg /g , while the lowest value is for it (0.612) mg/g.

Actually, The effect of the (4 SA) concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (0.785) mg/g in a 100 ppm concentration.

So Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values(0.814) in variety Abu-graib , but that the lowest value(0.616) mg /g in variety Abaa 99 .

At this time, the data of the Effect of varieties show higher value(0.762) mg /g That's for variety Abu-graib and lower at (0.717) mg /g That's for variety Abaa 99 .

On the end on The results for the effect that the highest values for *Pseudomonas fluorescens* it was (0.799) mg/g wet weight in 10^6 cfu./ml and lower on(0.645) mg/g .

4-2-2-3 : Effect of *Pseudomonas fluorescens* and salicylic acid in the Chlorophyll a+b Content :

Pseudomonas fluorescens and salicylic acid effected on the chlorophyll a+b of the *Triticum aestivum* . L varieties (Abaa 99 , Abu-graib).is seen in table (4.11) varieties there are significant differences with different concentrations with *Pseudomonas fluorescens* and salicylic acid of chlorophyll a+b content the highest value at *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (3.795) mg/g for variety Abu-graib. and the lowest value for the same variety it was (2.725) mg/g And its ratio of (39.2%) compared with the control.

Table (4.11) Effect of *Pseudomonas fluorescens* and salicylic acid in chl.a+b between the two varieties of *Triticum aestivum* .L.

Triticum aestivum .L	SA	Pseudomonas fluorescens				Interferenc evarieties × SA	Effect of varieties	Effect of SA			
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml						
Abaa 99	0	2.725 z	2.776 zy	2.791xy	2.757 za	2.762 h					
	50 ppm	2.860 v	3.402 E	3.261 h	3.041 q	3.141 e					
	100 ppm	2.903 t	3.089 o	3.560 C	3.059 P	3.153 D					
	150 ppm	2.878 u	3.106 no	3.12 mn	3.378 f	3.121 F					
Abu- graib	0	2.755 z	2.820 w	2.820 w	2.798 x	2.798 G					
	50 ppm	2.960 r	3.675 b	3.282 g	3.137 lm	3.263 B					
	100 ppm	3.020 r	3.186 K	3.795 a	3.144 l	3.286 A					
	150 ppm	3.003 r	3.207 j	3.242 i	3.434 d	3.222 c					
Interference varieties × Pseudomon as fluorescens	Abaa 99	2.841 h	3.093 e	3.184 c	3.059 f		3.044 b				
	Abu- Graib	2.935 g	3.222 b	3.285 a	3.128 d		3.142 a				
Interference SA × Pseudomon as fluorescens	0	2.740 o	2.798 m	2.806 m	2.778 n						2.780d
	50 ppm	2.910 l	3.538 b	3.272 d	3.089i						3.202b
	100 ppm	2.961 j	3.137 g	3.678 a	3.102 h				3.22A		
	150 ppm	2.941 k	3.156 f	3.183 e	3.406 c				3.171C		
Effect of Pseudomonas fluorescens		2.888 d	3.157 b	3.234 a	3.094 c						
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).											

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).

the result of interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (3.286) mg/g, While the values decreased significantly at the concentration of (50 and 150) ppm, respectively for the second variety of wheat Abaa 99 , the highest value is 100 ppm (3.153)) mg /g, and lower one at (2.762) mg /g .

The synergic interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the highest values (3.678) mg/g compared with other concentration , Followed by the value of SA1+PF1 (3.538) mg /g . The values gradually decrease from (3.272) mg /g , while the lowest value is for its value (2.740) mg/g.

Actually, The effect of the (4 SA) concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (3.220) mg/g in a 100 ppm concentration.

On the other hand , Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values(3.285) in variety Abu-graib , but that the lowest value(2.841) mg /g in variety Abaa 99 .

At this time, the data of the Effect of varieties show higher value(3.142) mg /g That's for variety Abu-graib and lower at (3.044) mg /g That's for variety Abaa 99 .

Finally , The results for the effect that the highest values for *Pseudomonas fluorescens* it was (3.234) mg / g wet weight in 10^6 cfu.ml⁻¹ and lower on(2.888) mg/g.

4-2-2-4 : Effect of *Pseudomonas fluorescens* and salicylic acid in the Chlorophyll a/b Content :

Pseudomonas fluorescens and salicylic acid effected on the chlorophyll a/b of the *Triticum aestivum* . L varieties (Abaa 99 , Abu-graib).is seen in table (4.12)

varieties there are significant differences with different concentrations with *Pseudomonas fluorescens* and salicylic acid of chlorophyll a/b content the highest value at a SA concentration of 50 ppm (SA1)), which was (3.707) mg / g and also 150ppm SA3 which was (3.609) it was took same litters And its ratio of (27.9%) ,(24.5%) respectively , compared with the control , for variety Abaa 99. and the lowest value for the same variety it was (2.898) mg/g .

Table (4.12) Effect of *Pseudomonas fluorescens* and salicylic acid in chl.a/b between the two varieties of *Triticum aestivum* .L.

Triticum aestivum .L	SA	<i>Pseudomonas fluorescens</i>				Interference varieties × SA	Effect of varieties	Effect of SA
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
Abaa 99	0	3.45 e	3.523 dc	3.536 dc	3.501 de	3.503 b		
	50 ppm	3.707a	2.911 nlm	2.898nm	3.272 g	3.197 D		
	100 ppm	3.60 b	3.154 i	2.842 op	3.207 h	3.203 Cd		
	150 ppm	3.668a	3.116 i	3.119 i	3.007 jk	3.227 cd		
Abu-graib	0	3.500de	3.568 bc	3.566 bc	3.543 dc	3.544 A		
	50 ppm	3.375 f	2.910 nlm	2.861 no	3.057 j	3.051 E		
	100 ppm	3.285 g	2.967 lk	2.940 lm	3.014jk	3.051 E		
	150 ppm	3.281 g	2.944 Lm	2.922 lm	2.800 p	2.987 F		
Interference varieties × <i>Pseudomonas fluorescens</i>	Abaa 99	3.609 a	3.176 D	3.099 ef	3.247 c		3.28 A	
	Abu-Graib	3.360 b	3.097 ef	3.072 f	3.103 e		3.15 B	
Interference SA × <i>Pseudomonas fluorescens</i>	0	3.476 b	3.546 a	3.551 a	3.522 a			3.524 A
	50 ppm	3.541 a	2.910 g	2.880 G	3.165 C			3.124Bc
	100 ppm	3.447 b	3.060 e	2.891 g	3.110 d			3.127 B
	150 ppm	3.474 b	3.030 Ef	3.021 f	2.903 g			3.107C
Effect of <i>Pseudomonas fluorescens</i>		3.485 a	3.136 c	3.086 d	3.175 B			

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test ($P < 0.05$).

the result of interference between varieties and concentrations of salicylic acid showed that the concentration(0ppm) significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (3.544) mg/g, While the values decreased significantly at the concentration for the second variety of wheat Abaa 99 and lower one at (2.987) mg/g .

The synergic interaction between SA and *Pseudomonas fluorescens* were noted that the FP1,FP2,FP3, SA1 has the highest values (3.546) mg/g ,(3.551) mg/g ,(3.522) mg/g (3.541) mg/g respectively that took the same letters compared with other concentration , Followed by the value of SA2,SA3 (3.447) mg /g , (3.474) mg /g respectively , while the lowest value is for its value (2.880) mg/g.

Actually, the effect of the (4 SA) concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (3.524) mg.

On the other hand , Interference varieties and *Pseudomonas fluorescens* indicate a they have the highest values(3.609) in variety Abaa 99 , but that the lowest value(2.841) mg /g show in variety Abu-graib.

At this time, the data of the Effect of varieties show higher value(3.283) mg /g That's for variety Abaa 99 and lower at (3.158) mg /g That's for variety Abu-graib .

Finally , The results for the effect that the highest values for *Pseudomonas fluorescens* it was (3.485) mg / g wet weight and lower on(3.086) mg/g.

4-2-2-5 : Effect of *Pseudomonas fluorescens* and salicylic acid in the Carotene Content :

Pseudomonas fluorescens and salicylic acid effected on the content of Carotene in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.13). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (0.969) mg/g for variety Abu-graib and the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (0.964) mg/g and for variety Abaa 99, And its ratio of (46.3%),(55.9%) respectively compared with the control .

In the other hand, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. while the lowest value is at (0.618) mg/g of the variety Abaa 99. On the other hand there are significant differences between them at ($p \leq 0.05$) because they took the differences letters .

Table (4.13) Effect of *Pseudomonas fluorescens* and salicylic acid in Carotene content between the two varieties of *Triticum aestivum* .L.

two varieties of <i>Triticum aestivum</i> .L.											
Triticum aestivum .L	SA	<i>Pseudomonas fluorescens</i>				Interferenc e varieties × SA	Effect of varietie s	Effect of SA			
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml						
Abaa 99	0	0.618 d	0.681 z	0.692 z	0.672 z	0.666 g					
	50 ppm	0.733 w	0.943 d	0.913 g	0.802 q	0.848 c					
	100 ppm	0.752 u	0.823 o	0.964ab	0.813 p	0.838 e					
	150 ppm	0.742 v	0.842 n	0.851 m	0.934 e	0.842 D					
Abu- graib	0	0.663 z	0.716 x	0.722 x	0.702 y	0.701 f					
	50 ppm	0.761 t	0.960 b	0.923 f	0.862 l	0.877 B					
	100 ppm	0.791 r	0.885 j	0.969 a	0.872 k	0.879 Ab					
	150 ppm	0.782 s	0.892 i	0.902 h	0.953 c	0.882 a					
Interference varieties × <i>Pseudomon</i> <i>as fluorescens</i>	Abaa 99	0.711	0.822 e	0.855 c	0.805 f		0.79 B				
	Abu- Graib	0.749 g	0.863 b	0.8793 a	0.847 d		0.83 A				
Interference SA × <i>Pseudomon</i> <i>as fluorescens</i>	0	0.641 p	0.699 n	0.707 m	0.687 o						0.683C
	50 ppm	0.747 l	0.952 b	0.918 d	0.832 i						0.862A
	100 ppm	0.772 j	0.854 g	0.967 a	0.843 h				0.859B		
	150 ppm	0.762 k	0.867 f	0.876 e	0.943 c				0.8627 a		
Effect of <i>Pseudomonas fluorescens</i>		0.730 d	0.8432 b	0.867 a	0.826 c						
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).											

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).

the of interference between varieties and concentrations of salicylic acid showed that the concentration 150 ppm ,100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (0.882) mg/g, (0.879) mg/g respectively , While the values decreased significantly at the concentration of (50) ppm, for the second variety of wheat Abaa 99 , the highest value is 150 ppm (0.842)) mg /g, and lower one at (0.666) mg /g .

The interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the highest values (0.967) mg/g compared with other concentration , Followed by the value of SA1+PF1 (0.952) mg /g . The values gradually decrease from 0.918mg /g , while the lowest value is for its (0.641) mg/g.

Actually,The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (0.8627) mg/g, (0.8626) mg/g in a 150 ppm , 50 ppm concentration respectively.

On the other hand ,Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu.ml⁻¹ they have the highest values(0.8793)mg/g in variety Abu-graib , but that the lowest value(0.711) mg /g in Abaa 99 at the concentration at control .

Here, the data of the Effect of varieties show higher value(0.835) mg /g That's for variety Abu-graib and lower at (0.799) mg /g That's for variety Abaa 99 .

At the latest on The results for the other variety that the highest values for *Pseudomonas fluorescens* it was (0.867) mg / g wet weight in 10^6 cfu.ml⁻¹ and lower on(0.730) mg/g .

Chl-a, chl-b, and carotenoids are the total pigment molecules present in the leaf, and they are necessary for photosynthesis. The key photosynthetic pigments, Chl-a and chl-b , are present in most plants. Plants that have a lot of chlorophyll are supposed to expand faster than those that don't. (Campbell and Reece, 2005) , chlorophyll plays a very significant role as a natural pigment in the absorption of light energy and growth promotion .Plant chlorophylls and carotenoids are highly colored, conjugated polyenes that play central roles in photosynthesis (Fahey *et al.*, 2005) .Plants differ from all species in the universe in that they have the ability to generate their own food, which was why they are classified as autotrophic . These powers are due to the existence of a green pigment chlorophylls.

The exogenous application of *Pseudomonas fluorescens* and SA can improve pigment content (chlorophyll and carotenoid), especially when combined. SA and *Pseudomonas fluorescens* use on the wheat *Triticum aestivum* L. in different concentrations as combination or alone , then the SA is used in methods treatment as spraying plants then *Pseudomonas fluorescens* incultation root, in the current study is found all the types of chlorophyll (a, b, a+b and a/b) and carotene they were

measured all common in the same concentration was more effect than others, and gave the high values (2.832, 0.963, 3.795, 3.707, 0.969) mg/g, in the (SA2+PF2) in the same wheat *Triticum aestivum* L for the chl.(a, b, a+b, a/b and carotene) respectively, but the content plant from chlorophyll and carotene reducing whenever increasing of concentrations from 100 ppm and *Pseudomonas fluorescens* concentrations from 10^6 c.f.u./ml .This corresponds to what he found : improvement in chlorophyll by *Pseudomonas fluorescens* and SA combination or sole (Khan, Banu, and Babar 2019).

The increase of chlorophyll at this concentration (SA2+PF2) may be due to the increase in the leaf area. Refer to the table (4.11) and noted this increase , the application of SA alone enhanced the chlorophyll content and photosynthetic rate and also neutralized the negative effect of the stress . The increase in the photosynthetic rate by SA may be the result of enhanced activity of Rubisco and PEP carboxylase under stress (Popova et al. 2003; Singh and Usha 2003) .

4-2-2-6 : Effect of *Pseudomonas fluorescens* and salicylic acid in the Stability of Plasma Membranes :

Pseudomonas fluorescens and salicylic acid effected on the Stability of Plasma Membranes in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.14). As for the effect of triple interference, it was the lowest value in below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (10.18%) for variety Abu-graib and the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (15.44%) for variety Abaa 99, compared with the control .In the other hand, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. while the highest value is at (45.28%) of the variety Abaa 99. On the

other hand there are significant differences between them at ($p \leq 0.05$) because they took the differences letters .

Table (4.14) Effect of *Pseudomonas fluorescens* and salicylic acid in Stability of Plasma Membranes between the two varieties of *Triticum aestivum* .L.

Triticum aestivum .L	SA	<i>Pseudomonas fluorescens</i>				Interferenc e varieties × SA	Effect of varietie s	Effect of SA
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
Abaa 99	0	45.28 a	40.33 d	36.22 e	43.31 C	41.28 a		
	50 ppm	30.35 g	17.54 p	20.00 o	25.25 k	23.28 d		
	100 ppm	28.36 h	24.56 L	15.44 r	24.28 l	23.16 d		
	150 ppm	30.21 g	23.20 m	21.41 n	20.27 o	23.77 c		
Abu- graib	0	44.38 b	33.21 f	33.31 f	36.42 e	36.83 B		
	50 ppm	27.19 i	11.52 S	20.01 o	21.51 n	20.06 f		
	100 ppm	25.18 k	21.24 n	10.18 t	21.51 n	19.53 g		
	150 ppm	26.34 j	20.33 o	20.03 o	16.31 q	20.75 e		
Interference varieties × <i>Pseudomona</i> <i>s fluorescens</i>	Abaa 99	33.55 a	26.41 D	23.27 f	28.28 c		27.88 a	
	Abu- Graib	30.77 b	21.58 g	20.88 h	23.94 e		24.29 b	
Interferenc e SA × <i>Pseudomo</i> <i>nas</i> <i>fluorescens</i>	0	44.83 a	36.77 c	34.77 d	39.87 b			39.06 a
	50 ppm	28.77 e	14.53 n	20.00 l	23.38 h			21.67 c
	100 ppm	26.77 g	22.90 i	12.81 o	22.89 i			21.34 d
	150 ppm	28.28 f	21.77 j	20.72 k	18.29 m			22.26 b
Effect of <i>Pseudomonas fluorescens</i>		32.16 a	23.99 c	22.07 d	26.11 b			
* Mean values followed by the same letter are not significantly different according to Duncan’s multiple range test (P < 0.05).								

the of interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (19.53%) , While the values increased significantly at the concentration of (50) ppm, for the second variety of wheat Abaa 99 , the lowest value for 100 ppm ,50 ppm is (23.16%) , (23.28) respectively and highest one at (41.28%) .

As for the interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the lowest values (12.81%) compared with other concentration , Followed by the value of SA1+PF1 (14.53%) . The values gradually increased from (18.29%) , while the highest value is for its (44.83%) .

The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the lowest value (21.34%) , in a 100 ppm concentration .

On the other hand , Interference varieties and *Pseudomonas fluorescens* indicate that (10^6 cfu.ml⁻¹) they have the lowest values(20.88%) in variety Abu-graib , but that the highest value(33.55%) in Abaa 99 at the concentration at control .

Here, the data of the Effect of varieties show lower value(24.29%) That's for variety Abu-graib and highest at (27.88%) That's for variety Abaa 99 .

At the latest on The results for the other variety that the lower values for impact *Pseudomonas fluorescens* it was (22.07%) in 10^6 cfu.ml⁻¹ and highest on(32.16%) .

However, according to findings, exogenous application of *Pseudomonas fluorescens* and SA can improve stability of the membrane, especially when combined. Use of *Pseudomonas fluorescens* and salicylic acid to plants the stability of the membrane in the cell plant in different plant *Triticum aestivum* That is clearly from table (4.14) results which showed the effects of *Pseudomonas fluorescens* and salicylic acid concentrations in feature stability of the membrane. for that reason the highest value at the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (10.18 %) for variety Abu-graib , was better, The membrane's stability is seen in table (4.14), with the plasma membrane playing a critical role in the cell's life since it regulates the molecules that reach and leave the cell. In this case, SA helps to boost the role of the plasma membrane by increasing its integrity and protecting the cell by reducing damage proof. The perfect concentration of (SA2+PF2). The conservation membrane roles were aided by SA. This may be due to the activation of antioxidant responses and increased Ca^{+2}

absorption, which prevents the plant from oxidative damage caused by SA. (El-Tayeb, 2005; Seneratna *et al.*, 2000).

4-2-2-7 : Effect of *Pseudomonas fluorescens* and salicylic acid in the Permeability of Potassium (K^+) :

Pseudomonas fluorescens and salicylic acid effected on the Permeability of Potassium (K^+) in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.15). As for the effect of triple interference, it was the lowest value in below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (8.75%) for variety Abu-graib and the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (11.11%) for variety Abaa 99, which both that took same letters , compared with the control .

on the other hand, there are substantial variations between them at ($p \leq 0.05$) different letters was take , while the highest value is at (109.06%) of the variety Abaa 99. On the other hand there are no significant differences between them at ($p \leq 0.05$) because they took the same letters .

Table (4.15) Effect of *Pseudomonas fluorescens* and salicylic acid in Permeability of Potassium (K⁺) between the two varieties of *Triticum aestivum* .L.

Triticum .L aestivum	SA	<i>Pseudomonas fluorescens</i>				Interfere nce varieties × SA	Effect of varietie s	Effect of SA
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
<i>Abaa</i> 99	0	56.63 b	109.06 a	33.89 bc	46.01bc	61.39 a		
	50 ppm	28.32 bc	15.23 c	19.34 bc	26.33bc	22.30 B		
	100 ppm	28.24 bc	23.77 bc	11.11 c	24.19bc	21.82 B		
	150 ppm	28.30 bc	23.18 bc	22.42 bc	16.63bc	22.63 B		
<i>Abu- graib</i>	0	46.94 bc	30.95 bc	29.38 bc	32.29bc	34.88 B		
	50 ppm	26.92 bc	10.67 c	17.93 bc	22.40bc	19.48 B		
	100 ppm	26.68 bc	21.46 bc	8.75 c	22.51bc	19.85 B		
	150 ppm	27.44 bc	21.95 bc	20.01 bc	14.52 c	20.97 B		
Interference varieties × <i>Pseudomonas fluorescens</i>	<i>Abaa</i> 99	35.36 ba	42.81 A	21.69 b	28.29 ab		32.04a	
	<i>Abu- Graib</i>	31.99 ab	21.25 b	19.01 b	22.93 b		23.80b	
Interference SA × <i>Pseudomona s fluorescens</i>	0	51.78 ab	70.01 a	31.63bcd	39.15 bc			48.14 a
	50 ppm	27.62bcd	12.95 cd	18.63 cd	24.37 cd			20.89b
	100 ppm	27.46bcd	22.62 cd	9.93 d	23.35 cd			20.84b
	150 ppm	27.87bcd	22.56 cd	21.21 cd	15.58 cd			21.80b
Effect of <i>Pseudomonas fluorescens</i>		33.68 a	32.03 ba	20.35 b	25.61Ab			
* Mean values followed by the same letter are not significantly different according to Duncan’s multiple range test (P < 0.05).								

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).

the of interference between varieties and concentrations of salicylic acid showed that the concentration no significantly different at probability level (5%) compared to other concentrations, but the lowest values in variety Abaa 99, (21.82%) , While the values increased significantly at the concentration of (150) ppm, for the second variety of wheat Abu-graib , the lowest value for 50 ppm is (19.48%)) and highest one at (34.88%) , but no significantly different varieties because they took same letters .

As for the interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the lowest values (9.93%) compared with other concentration , Followed by the value of SA1+PF1 (12.95%) . The values gradually increased from (15.58%) , while the highest value is for its (70.01%) .

Actually, The effect of the (4 SA) concentrations was found to be substantially different from the control at a probability rate of (5%), with the lowest value (21.80%) , in a 150 ppm concentration .

On the other hand , Interference varieties and *Pseudomonas fluorescens* indicate that (10^6 cfu/ml) they have the lowest values(19.01%) in variety Abu-graib , but that the highest value(42.81%) in Abaa 99 at the concentration at control .

Here, the data of the Effect of varieties show lower value(23.80%) That's for variety Abu-graib and highest at (32.04%) That's for variety Abaa 99 .

At the latest on The results for the other variety that the lower values for impact *Pseudomonas fluorescens* it was (20.35%) in 10^6 cfu.ml⁻¹ and highest on(33.68%) .

4-2-2-8 : Effect of *Pseudomonas fluorescens* and salicylic acid in the Sodium Permeability of (Na⁺) :

Pseudomonas fluorescens and salicylic acid effected on the Sodium Permeability of (Na⁺) in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.16). As for the effect of triple interference, it was the lowest value in below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^5) c.f.u./ml (FP1) for a SA concentration of 50 ppm (SA1)), which was (17.383%) for variety Abu-graib and the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (18.250%) for variety Abaa 99 , compared with the control .

on the other hand, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. while the highest value is at (58.014%) of the variety Abaa

99. On the other hand there are significant differences between them at ($p \leq 0.05$) because they took the different letters .

Table (4.16) Effect of *Pseudomonas fluorescens* and salicylic acid in Sodium Permeability of (Na^+) between the two varieties of *Triticum aestivum* .L.

Triticum aestivum .L	SA	Pseudomonas fluorescens				Interference varieties × SA	Effect of varieties	Effect of SA
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
Abaa 99	0	58.01 a	39.48 c	35.756 cd	39.283 c	43.13a		
	50 ppm	31.087 fe	19.246ln	20.530 kl	27.545 fi	24.60 d		
	100 ppm	30.807 fe	26.823 fi	18.250 nm	27.399 fi	25.82 c		
	150 ppm	30.480 fe	25.849 kf	24.258 kl	19.525 ln	25.02 cd		
Abu- graib	0	44.303 b	33.796 ed	31.537 fe	30.989 fe	35.15 b		
	50 ppm	29.647 fe	17.383 n	21.464 kl	22.806 kl	22.82 d		
	100 ppm	27.868 fi	21.821 kl	23.375 kl	22.657 kl	23.93 cd		
	150 ppm	28.803 fe	20.773 kl	20.933 kl	19.453 ln	22.49 d		
Interference varieties × Pseudomon as fluorescens	Abaa 99	37.59 a	27.84 c	24.69 d	28.43 c		29.64a	
	Abu- Graib	32.65 b	23.44 d	24.32 d	23.97 d		26.1b	
Interference SA × Pseudomon as fluorescens	0	51.15 a	36.63 B	33.64 bc	35.13 b			39.14a
	50 ppm	30.36 Dc	18.31 h	20.99 ge	25.17 e			23.71b
	100 ppm	29.33 d	24.32 ef	20.81 fe	25.02 e			24.87b
	150 ppm	29.64 d	23.31 ef	22.59 fe	19.48 gh			23.75b
Effect of Pseudomonas fluorescens		35.12 a	25.64 b	24.51 b	26.20 B			
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).								

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test ($P < 0.05$).

the of interference between varieties and concentrations of salicylic acid showed that the concentration significantly different at probability level (5%) compared to other concentrations, but the lowest values in variety Abu-graib, (22.49%) , While the values increased significantly at the concentration of (50) ppm, for the same variety of wheat Abu-graib , in variety Abaa 99 the lowest value for 50 ppm is (24.60%)) and highest one at (43.13%) , but significantly different varieties because they took different letters .

As for the interaction between SA and *Pseudomonas fluorescens* were noted that the SA1+PF1 has the lowest values (18.31%) compared with other concentration , Followed by the value of SA2+PF2 (20.81%) . The values gradually increased from (20.99%) , while the highest value is for its (51.15%) .

Actually, The effect of the (4 SA) concentrations was found to be substantially different from the control at a probability rate of (5%), with the lowest value (23.71%) , in a 50 ppm concentration .

On the other hand ,Interference varieties and *Pseudomonas fluorescens* indicate that (10^6 cfu.ml⁻¹) they have the lowest values(23.44%) in variety Abu-graib , but that the highest value(51.15%) in Abaa 99 at the concentration at control .

Here, the data of the Effect of varieties show lower value(26.10%) That's for variety Abu-graib and highest at (29.64%) That's for variety Abaa 99 .

At the latest on The results for the other variety that the lower values for impact *Pseudomonas fluorescens* it was (24.51%) in 10^6 cfu./ml and highest on(35.12%) , but no significantly different between concentration because took same letters .

The exogenous application of *Pseudomonas fluorescens* and SA can improve prevent permeability of two ions K⁺ and Na⁺ respectively, especially when combined. Table (4.15)and (4.16) show the effect of salicylic acid in prevent permeability of two ions K⁺ and Na⁺ respectively . So using of the *Pseudomonas fluorescens* and SA is positive effects in reducing of measuring of K⁺ and Na⁺ as showed at table (4.14), practically in concentration of (SA2+PF2) , (SA1+PF1) and the values were (8.75% ,17.383 %) for both (K⁺ and Na⁺) respectively. When the permeability of k⁺ and Na⁺ are reduced together, the results were damage effects on the ion passes through the membrane. Obviously, any damage to the plasma membrane leads to an increase in the permeability of all ions (K⁺ and Na⁺). However, the combined or single effect of *Pseudomonas fluorescens* and salicylic acid has decreased it, resulting in the plasma membrane's work or job being unable to keep the cell healthy. all this

opinion is agreement with what found by (Bijanzadeh, *et al.*, 2019), (Abbasi Seyahjani *et al.*, 2017) .

4-2-2-9 : Effect of *Pseudomonas fluorescens* and salicylic acid in the Water Content of Leaf Tissue :

Pseudomonas fluorescens and salicylic acid effected on the Water Content of Leaf Tissue in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.17). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (90.63%) for variety Abu-graib , compared with the control .

In the other hand, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (88.77%) while the lowest value is at (60.02%) .On the other hand there are significant differences between them at ($p \leq 0.05$) because they took the differences letters .

Table (4.17) Effect of *Pseudomonas fluorescens* and salicylic acid in Water Content of Water Content of Leaf Tissue between the two varieties of *Triticum aestivum* .L.

Triticum aestivum .L	SA	<i>Pseudomonas fluorescens</i>				Interferen ce varieties × SA	Effect of varietie s	Effect of SA
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
<i>Abaa</i> 99	0	60.02 z	61.14 y	62.19 x	60.98 y	61.08 g		
	50 ppm	64.45 v	86.26 e	83.66 h	70.18 r	76.14 c		
	100 ppm	68.32 t	73.25 p	88.77 c	71.33 q	75.42 d		
	150 ppm	65.32 u	74.29 o	75.46 n	85.35 f	75.11e		
<i>Abu- graib</i>	0	60.57 z	63.11 w	63.26 w	62.33 x	62.32 f		
	50 ppm	68.56 t	89.46 b	84.21g	76.33 m	79.64 a		
	100 ppm	69.42 s	79.55 k	90.63 a	77.80 l	79.35 b		
	150 ppm	69.18 s	80.41 j	81.36 i	87.72 d	79.67 a		
Interference varieties × <i>Pseudomon</i> <i>as</i> <i>fluorescens</i>	<i>Abaa</i> 99	64.53 h	73.74 e	77.52 c	71.96 F		71.94b	
	<i>Abu- graib</i>	66.93 g	78.13b	79.87 a	76.05 d		75.24a	
Interferenc e SA × <i>Pseudomo</i> <i>nas</i> <i>fluorescen</i> <i>s</i>	0	60.29 p	62.13 n	62.73 m	61.66 o		61.70c	
	50 ppm	66.50 l	87.86 b	83.94 e	73.26 i		77.89a	
	100 ppm	68.87 j	76.40 g	89.70 a	74.56 h		77.38b	
	150 ppm	67.25 k	77.35 f	78.41 e	86.53 c		77.39b	
Effect of <i>Pseudomonas</i> <i>fluorescens</i>		65.73 d	75.93 b	78.69 a	74.00 c			
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).								

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).

the of interference between varieties and concentrations of salicylic acid showed that the concentration 50 ppm ,150 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (79.64%), (79.67) respectively they both took same letters ,While the values decreased significantly at the concentration of (100 ppm), for the second variety of wheat Abaa 99 , the highest value is 100 ppm (75.42%) and lower one at (61.08%) .

As for the interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the highest values (89.70%) compared with other concentration , Followed by the value of SA1+PF1 (87.86%) . The values gradually decrease from 86.53% , while the lowest value is (60.29%) .

Actually, The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (77.89%) in a 50 ppm concentration.

On the other hand , Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu.ml⁻¹ they have the highest values(79.87%) in variety Abu-graib , but that the lowest value(64.53) in Abaa 99 at the concentration at control .

Here, the data of the Effect of varieties show higher value(75.24%) That's for variety Abu-graib and lower at (71.94%) That's for variety Abaa 99 .

At the latest on The results for the other variety that the highest values for *Pseudomonas fluorescens* it was (78.69%) in 10^6 cfu.ml⁻¹ and lower on(65.73%) .

Use of *Pseudomonas fluorescens* and salicylic acid to plants increased the water content in the cell plant in different plant *Triticum aestivum* That is clearly from table (4.17) results which showed the effects of *Pseudomonas fluorescens* and salicylic acid concentrations in feature water content. for that reason the highest value at the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (90.63%) for variety Abu-graib , was better,

Table (4.16) reveals that the water content in the cells plant in the whole plant body is not just for thirst, but also as a for metabolic processes, making the plant more rigid and robust. As a result, the influence of *P. fluorescens* and salicylic acid on raising the water content, especially in the concentration (SA2+PF2), is seen.and perfect value is (90.63%) ,followed by the effect of (SA1+PF1) in the same treatment and in variety Abu-graib, likewise the plant Abaa 99 took the minimum value at (60.02)%, (Roumani et al., 2019) discovered that when the cell plant was treated with

various levels of salicylic acid, the water content increased, perhaps because the concentration of ions and chemical compounds increased the osmosis potential, allowing the plant to absorb more water. The acid is also thought to play a role in decreasing water loss by transpiration and evaporation by regulating the flow in stomata, improving the negative osmotic potential of the leaves by the accumulation of amino acids and sugars, and further enhancing the capacity and speed at which the roots consume water and thus increasing the plant's water content. (Naghashzadeh, 2014). This is consistent with what he says that *Pseudomonas* increase the relative water content (Bano and Fatima, 2009).

4-2-2-10 : Effect of *Pseudomonas fluorescens* and salicylic acid in the carbohydrates :

Pseudomonas fluorescens and salicylic acid effected on the carbohydrates in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.18). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (55.553 mg/g dry weight) for variety Abu-graib , compared with the control .

The flip side, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (88.77%) while the lowest value is at (35.363 mg/g dry weight) .otherwise , there are significant differences between them at ($p \leq 0.05$) because they took the differences letters .

Table (4.18) Effect of *Pseudomonas fluorescens* and salicylic acid in carbohydrates (mg/g dry weight) between the two varieties of *Triticum aestivum* .L.

Triticum aestivum L m	SA	Pseudomonas fluorescens				Interference varieties × SA	Effect of varieties	Effect of SA	
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml				
Abaa 99	0	4.158 u	6.272 t	7.903 s	5.556tu	5.972 f			
	50 ppm	15.388 pq	32.630 de	31.42 ef	21.466 l	25.228d			
	100 ppm	16.520po	27.450 jk	35.363 c	26.416 k	26.437c			
	150 ppm	16.466 po	27.540 Jki	27.566jki	31.72ef	25.82 cd			
Abu- graib	0	4.587 u	12.550 r	14.660 q	11.633 r	10.857e			
	50 ppm	17.406 n	37.490 b	31.540 ef	28.29jhi	28.681 b			
	100 ppm	19.526m	29.686 gh	55.553 a	29.20gh	33.491a			
	150 ppm	18.507mn	30.333 gh	30.660 gf	33.613 d	28.278b			
Interference varieties × Pseudomonas fluorescens	Abaa 99	13.133g	23.473 d	25.564 c	21.291 e		20.8b		
	Abu- graib	15.006 f	27.515 b	33.103 a	25.684C		25.32a		
Interference SA × Pseudomonas fluorescens	0	4.372 l	9.411 k	11.281 j	8.595 k			8.41c	
	50 ppm	16.397 i	35.060 b	31.483 d	24.878 g			26.9b	
	100 ppm	18.023 h	28.568 ef	45.458 a	27.808 f			29.9a	
	150 ppm	17.486 h	28.936 ef	29.113 e	32.670 c			27.0b	
Effect of Pseudomonas fluorescens		14.070 d	25.494 b	29.334 a	23.487 c				
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).									

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).

the of interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (33.491 mg/g dry weight) ,While the values decreased significantly at the concentration of (150 ppm), for the second variety of wheat Abaa 99 , the highest value is 100 ppm (26.437 mg/g dry weight) and lower one at (5.972 mg/g dry weight) .

As for the interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the highest values (45.458 mg/g dry weight) compared with other concentration , Followed by the value of SA1+PF1 (35.060 mg/g dry weight) . The values gradually decrease from (32.670 mg/g dry weight) , while the lowest value is (4.372 mg/g dry weight) .

Actually, The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (29.964 mg/g dry weight) in a 100 ppm concentration.

On the other hand , Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values(33.103 mg/g dry weight) in variety Abu-graib , but that the lowest value(13.133 mg/g dry weight) in Abaa 99 at the concentration at control .

So the data of the Effect of varieties show higher value(25.324 mg/g dry weight) That's for variety Abu-graib and lower at (20.865 mg/g dry weight) That's for variety Abaa 99 .

Eventually , The results for the other variety that the highest values for *Pseudomonas fluorescens* effect it was (29.334 mg/g dry weight) in 10^6 cfu./ml and lower on(14.07 mg/g dry weight) .

During the time of stem elongation to the early stage of grain filling, carbohydrates , mostly glucose, fructose, sucrose, and fructans, stored in the stem and sheath of wheat, which could be remobilized during the later stage of grain filling. (Wardlaw and Willenbrink, 2000).In wheat and barley, a carbohydrate reserve is a significant carbon source for grain yield (Bonnett and Incoll, 1993; Schnyder, 1993).

Carbohydrates are the main energy source in cells and all animals, and plants produce them as product materials during the photosynthesis reaction by converting raw materials into complex compounds in the chloroplast, a tiny organelle. As a result, in terms of the chlorophyll content in the chloroplast of a cell. Growing carbohydrates supports both the cell and the plant in either case. Therefore SA and *Pseudomonas fluorescens* from data the table (4.18) showed effecting in the amounts

of carbohydrates in the wheat *Triticum aestivum* L, particularly at concentration SA2+PF2 in the both varieties (Abaa 99 and Abu-graib) they has values of carbohydrates at (88.33, 88.00) mg/g. The increase in carbohydrates at this concentration (SA2+PF2) may be due to the increase in the leaf area and chlorophyll, refer to the table (4.2) and the table (4.10) and noted this increase .

Although the minimum values for both varieties are at a different concentration. Attempting to explain these effect of increasing chlorophyll in (a and b) as well as carotene amount, look at table (4.13), (4.14), (4.17), which indicates a favorable interaction, implying that increasing chlorophyll requires increasing carbohydrate quantities. (Azeem *et al.*, 2019) ,Although some experiments have discovered that SA and *Pseudomonas fluorescens* work to increase the concentration of carbohydrates by stimulating and preserving organelles and their operation, like chloroplasts, which leads to the development of carbohydrates, and in the plant's capacity to absorb the elements that lead to an ion exchange, others have discovered that SA and *Pseudomonas fluorescens* work to increase the concentration of carbohydrates because it has a role in regulating the inner genes of the cell in inducing (Kaydan *et al.*, 2007). improvement in carbohydrates by *Pseudomonas fluorescens* and SA combination or sole (Khan, Banu, and Babar 2019).

4-2-2-11 : Effect of *Pseudomonas fluorescens* and salicylic acid in the nitrogen :

Pseudomonas fluorescens and salicylic acid effected on the nitrogen in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.19). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (1.190 %) for variety Abu-graib , compared with the control .

The same time, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2), which was (0.926 %) while the lowest value is at (0.156 %) .otherwise, there are significant differences between them at ($p \leq 0.05$) because they took the differences letters.

Table (4.19) Effect of *Pseudomonas fluorescens* and salicylic acid in (N%) between the two varieties of *Triticum aestivum* .L.

.T aestivu m	SA	<i>Pseudomonas fluorescens</i>				Interferenc e varieties × SA	Effect of varietie s	Effect of SA
		0	10 ⁵ c.f.u./m l	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
Abaa 99	0	0.156 m	0.280 k	0.283 k	0.283 k	0.250 f		
	50 ppm	0.363 j	0.646 e	0.503 g	0.436 hi	0.487 c		
	100 ppm	0.353 j	0.423hi	0.926 c	0.426 hi	0.532 c		
	150 ppm	0.340 j	0.416hi	0.430 hi	0.566 f	0.438 d		
Abu- graib	0	0.216 l	0.343 j	0.340 j	0.296 k	0.299 e		
	50 ppm	0.406 i	1.113 b	0.550 f	0.443 h	0.628 a		
	100 ppm	0.41hi	0.480 g	1.190 a	0.486 g	0.642 a		
	150 ppm	0.416hi	0.486 g	0.480 g	0.746 d	0.532 b		
Interferen ce varieties × <i>Pseudom onas fluoresce ns</i>	Abaa 99	0.303 g	0.441 e	0.535 c	0.428 e		0.427 b	
	Abu- graib	0.363 f	0.605 b	0.640 a	0.493 d		0.525 a	
Interferen ce SA × <i>Pseudom onas fluoresce ns</i>	0	0.186 i	0.311 g	0.311 g	0.290 h			0.275 d
	50 ppm	0.385 f	0.880 b	0.456 d	0.440 e			0.557 b
	100 ppm	0.383 f	0.451 e	1.058 a	0.456 e			0.5875 a
	150 ppm	0.378 f	0.451 e	0.455 e	0.656 c			0.485 c
Effect of <i>Pseudomonas fluorescens</i>		0.333 d	0.523 b	0.587 a	0.460 c			
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).								

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test ($P < 0.05$).

beginning, the effect of interference between varieties and concentrations of salicylic acid showed that the concentration 100, 50 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (0.642 %, 0.628 %) respectively, While the values decreased significantly at the concentration of (150 ppm), for the second variety of wheat Abaa 99, the highest value is 100 ppm (0.532 %) and lower one at (0.250 %).

As for the interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the highest values (1.058 %) compared with other concentration, Followed by the value of SA1+PF1 (0.880 %) . The values gradually decrease from (0.656 %) , while the lowest value is (0.186 %) .

Actually, The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (0.5875 %) in a 100 ppm concentration.

On the other hand, Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values (0.640 %) in variety Abu-graib, but that the lowest value (0.303 %) in Abaa 99 at the concentration at control .

This place, the data of the Effect of varieties show higher value (0.525 %) That's for variety Abu-graib and lower at (0.427 %) That's for variety Abaa 99 .

At last, The results for that the highest values for *Pseudomonas fluorescens* effect it was (0.587 %) in 10^6 cfu./ml and lower on (0.333 %) .

4-2-2-12 : Effect of *Pseudomonas fluorescens* and salicylic acid in the phosphate :

Pseudomonas fluorescens and salicylic acid effected on the phosphate in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.20). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2) , which was (0.518 %) and the low concentration *P. fluorescens* (10^5) c.f.u./ml (FP1) for a SA concentration of 50 ppm (SA1) , which was (0.513 %) for variety Abu-graib , because took same letters , compared with the control.

simultaneously, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2) , which was (0.492 %) while the lowest value is at (0.116 %) .otherwise , there are significant differences between them at ($p \leq 0.05$) because they took the differences letters .

Table (4.20) Effect of *Pseudomonas fluorescens* and salicylic acid in (P %) between the two varieties of *Triticum aestivum* .L.

Triticum aestivu .L m	SA	Pseudomonas fluorescens				Interferenc e varieties × SA	Effect of varietie s	Effect of SA
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
Abaa 99	0	0.116 o	0.213 ml	0.236 k	0.224 kl	0.197 d		
	50 ppm	0.176 N	0.478 bc	0.436 d	0.331 h	0.355 b		
	100 ppm	0.203 M	0.395 ef	0.492 b	0.333 h	0.356 b		
	150 ppm	0.168 N	0.373 g	0.383 fg	0.469 c	0.348 b		
Abu- Graib	0	0.167 N	0.255 j	0.294 i	0.285 i	0.250 c		
	50 ppm	0.204 m	0.513 a	0.438 d	0.392 ef	0.387 a		
	100 ppm	0.208 Ml	0.402 ef	0.518 a	0.402ef	0.382 a		
	150 ppm	0.204 m	0.408 e	0.427 d	0.488 b	0.382 a		
Interferenc e varieties × Pseudomo nas fluorescen s	Abaa 99	0.165 f	0.364 c	0.387 b	0.339 d		0.314 b	
	Abu- graib	0.196 e	0.394 b	0.419 a	0.392b		0.350 a	
Interferenc e SA × Pseudomo nas fluorescen s	0	0.141 K	0.234 h	0.265 g	0.254 g			0.224 c
	50 ppm	0.190 j	0.495 a	0.437 c	0.361 f			0.371 a
	100 ppm	0.205 I	0.398 ed	0.505 a	0.368 f			0.369 a
	150 ppm	0.186 J	28.936 ef	0.405 d	0.479 b			0.365 a
Effect of Pseudomonas fluorescens		0.180 d	0.379 b	0.403 a	0.365 c			
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).								

let's clarify, the of interference between varieties and concentrations of salicylic acid showed that the concentration 50 ,100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (0.387 % ,0.382 %) respectively ,While the values no decreased significantly at the concentration of (150 ppm), for the second variety of wheat Abaa 99 , the highest

value is 100 ppm (0.356 %) but no significant differences between them at ($p \leq 0.05$) because they took the same letters . and lower one at (0.197 %) .

As for the interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the highest values (0.505 %) compared with other concentration , Followed by the value of SA1+PF1 (0.495 %) . The values gradually decrease from (0.479 %) , while the lowest value is (0.141 %) .

Actually, The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (0.371 %) in a 50 ppm concentration , but no significant differences between them at ($p \leq 0.05$) because they took the same letters .

Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values (0.419 %) in variety Abu-graib , while that the lowest value (0.165 %) show in Abaa 99 at the concentration control .

So the data of the Effect of varieties show higher value (0.350 %) That's for variety Abu-graib and lower at (0.314 %) That's for variety Abaa 99 .

Finally , The results for that the highest values for *Pseudomonas fluorescens* effect it was (0.403 %) in 10^6 cfu./ml and lower on (0.180 %) .

4-2-2-13 : Effect of *Pseudomonas fluorescens* and salicylic acid in the potassium :

Pseudomonas fluorescens and salicylic acid effected on the potassium in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.21). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6)

c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (2.370 %) and the low concentration *P. fluorescens* (10^5) c.f.u./ml (FP1) for a SA concentration of 50 ppm (SA1)), which was (2.170 %) for variety Abu-graib , because took same letters , compared with the control.

Together , there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (2.146 %) while the lowest value is at (0.756 %) .otherwise , there are significant differences between them at ($p \leq 0.05$) because they took the differences letters .

Table (4.21) Effect of *Pseudomonas fluorescens* and salicylic acid in (K %) between the two varieties of *Triticum aestivum* .L.

Triticum aestivu .L m	SA	Pseudomonas fluorescens				Interferenc e varieties × SA	Effect of varietie s	Effect of SA	
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml				
Abaa 99	0	0.756 k	1.140 ij	1.260 hij	1.130 ji	1.071 c			
	50 ppm	1.380 Hig	2.023bad	1.880bde	1.613fhde	1.724 ab			
	100 ppm	1.413Fhig	1.686fdeg	2.146bac	1.626fhde	1.718 ab			
	150 ppm	1.390Hig	1.710fdeg	1.716fdg	1.980bde	1.699 ab			
Abu- graib	0	1.290Hij	1.270hig	0.970 kj	1.270hij	1.200 c			
	50 ppm	1.450fhg	2.170ab	1.960bde	1.743fdeg	1.830 a			
	100 ppm	1.476 Fhig	1.770fdeg	2.370 a	1.763fdec	1.845 a			
	150 ppm	1.463 Fhig	1.783fbde	1.810fbd	1.466fhig	1.630 b			
Interferenc e varieties × Pseudomo nas fluorescen s	Abaa 99	1.235 d	1.640bc	1.750 ab	1.587bc		1.553 a		
	Abu- graib	1.340 d	1.748ab	1.857 a	1.560 c		1.626 a		
Interferenc e SA × Pseudomo nas fluorescen s	0	0.863 F	1.205 e	1.275 e	1.200 e				1.135 b
	50 ppm	1.415 E	2.096 ab	1.920 bc	1.678 cd				1.777 a
	100 ppm	1.445 De	1.728 c	2.258 a	1.695 c				1.781 a
	150 ppm	1.426 e	1.746 c	1.763 c	1.723 c				1.665 a
Effect of Pseudomonas fluorescens		1.287 c	1.694 a	1.804 a	1.574 b				
* Mean values followed by the same letter are not significantly different according to Duncan’s multiple range test (P < 0.05).									

Begin to see , the of interference between varieties and concentrations of salicylic acid showed that the concentration 100 ,50 ppm takes the highest values significantly

at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (1.845 % , 1.830 %) respectively ,While the values decreased significantly at the concentration of (150 ppm), for the second variety of wheat Abaa 99 , the highest value is 50 ppm (1.724%) but no significant differences between them at ($p \leq 0.05$) because they took the same letters . and lower one at (1.071%) .

With regard to the interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the highest values (2.258 %) compared with other concentration , Followed by the value of SA1+PF1 (2.096%) . The values gradually decrease from (1.763%) , while the lowest value is (0.863%) .

Actually, The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (1.781 %) in a 100 ppm concentration , but no significant differences between them at ($p \leq 0.05$) because they took the same letters .

On the other hand ,Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values(1.857%) in variety Abu-graib , but that the lowest value(1.235 %) in Abaa 99 at the concentration control .

Here, the data of the Effect of varieties show higher value(1.626 %) That's for variety Abu-graib and lower at (1.553%) That's for variety Abaa 99 . but no significant differences between them at ($p \leq 0.05$) because they took the same letters .

Eventually, The results for that the highest values for *Pseudomonas fluorescens* effect it was (1.804 %) in 10^6 cfu./ml and lower on(1.287 %) .

4-2-2-14 : Effect of *Pseudomonas fluorescens* and salicylic acid in the Magnesium :

Pseudomonas fluorescens and salicylic acid effected on the Magnesium in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.22). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (1.023%) , compared with the control . Concurrently , there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (0.836%) while the lowest value is at(0.406%) .otherwise , there are significant differences between them at ($p \leq 0.05$) because they took the differences letters .

Table (4.22) Effect of *Pseudomonas fluorescens* and salicylic acid in (Mg %) between the two varieties of *Triticum aestivum* .L.

Triticum aestivum L m	SA	Pseudomonas fluorescens				Interference varieties × SA	Effect of varieties	Effect of SA	
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml				
Abaa 99	0	0.406 u	0.476 S	0.496 r	0.470 s	0.462 h			
	50 ppm	0.546 Pq	0.806 D	0.726 g	0.606 M	0.671 d			
	100 ppm	0.570 o	0.623 l	0.836 c	0.613 l	0.660 e			
	150 ppm	0.556 P	0.636 j	0.633 j	0.780 e	0.651 f			
Abu- graib	0	0.450 T	0.536q	0.540 q	0.533 q	0.515 g			
	50 ppm	0.576 o	0.880 b	0.746 f	0.643 j	0.711 b			
	100 ppm	0.590 N	0.670 i	1.023 a	0.646 j	0.732 a			
	150 ppm	0.580 No	0.676 i	0.696 h	0.813 d	0.691 c			
Interference varieties × Pseudomonas fluorescens	Abaa 99	0.520 h	0.635 e	0.673 c	0.617 f				0.611 b
	Abu- graib	0.549 g	0.690 b	0.751 a	0.659 d				0.662 a
Interference SA × Pseudomonas fluorescens	0	0.428 L	0.506 k	0.518 j	0.501 k				0.488 d
	50 ppm	0.561 l	0.843 b	0.736 d	0.625 g				0.691 B
	100 ppm	0.580H	0.646 f	0.930 a	0.630 g				0.696 A
	150 ppm	0.568 i	0.656 e	0.665 e	0.796 c				0.671 c
Effect of Pseudomonas fluorescens		0.534 d	0.663 b	0.712 a	0.638 c				
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).									

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).

Opening , the of interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (0.732%) ,While the values decreased significantly at the concentration of (50 ppm), for the second variety of wheat Abaa 99 , the highest value is 50 ppm (0.671%) and lower one at (0.462%) .

relating to the interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the highest values (0.930%) compared with other concentration , Followed by the value of SA1+PF1 (0.843%) . The values gradually decrease from (0.796%) , while the lowest value is (0.428%) .

Actually, The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (0.696 %) in a 100 ppm concentration .

On the other hand , Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values (0.751%) in variety Abu-graib , but that the lowest value (0.520%) in Abaa 99 at the concentration control .

This point, the data of the Effect of varieties show higher value (0.662%) That's for variety Abu-graib and lower at (0.611%) That's for variety Abaa 99 .

At the end , The results for that the highest values for *Pseudomonas fluorescens* effect it was (0.712%) in 10^6 cfu./ml and lower on (0.534 %).

4-2-2-15 : Effect of *Pseudomonas fluorescens* and salicylic acid in the calcium :

Pseudomonas fluorescens and salicylic acid effected on the calcium in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.23). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (0.236 %) and the low concentration *P. fluorescens* (10^5) c.f.u./ml (FP1) for a SA concentration of 50 ppm (SA1)), which was (0.233%) for variety Abu-graib , because took same letters , compared with the control.

In unison, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (0.213 %) while the lowest value is at (0.044%)

otherwise, there are significant differences between them at ($p \leq 0.05$) because they took the differences letters.

Table (4.23) Effect of *Pseudomonas fluorescens* and salicylic acid in (Ca %) between the two varieties of *Triticum aestivum* L.

Triticum aestivum L m	SA	Pseudomonas fluorescens				Interference varieties × SA	Effect of varieties	Effect of SA
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
Abaa 99	0	0.044 o	0.051 o	0.061mn	0.05no	0.052 f		
	50 ppm	0.070 kml	0.200 c	0.143 f	0.080 kj	0.123 c		
	100 ppm	0.070 kml	0.103 i	0.213 b	0.086 j	0.118 d		
	150 ppm	0.070 kml	0.100 i	0.106 hi	0.190 D	0.116 d		
Abu- graib	0	0.070 kml	0.066 ml	0.080 kj	0.062Mn	0.062 e		
	50 ppm	0.076 kj	0.233 a	0.176 e	0.110 h	0.147 a		
	100 ppm	0.042 o	0.116 h	0.236 a	0.110 Hi	0.135 b		
	150 ppm	0.070 kml	0.130 g	0.136 gf	0.210 b	0.136 b		
Interference varieties × Pseudomonas fluorescens	Abaa 99	0.063 g	0.113 E	0.131 c	0.102 f		0.102b	
	Abu- graib	0.06 g	0.136 b	0.157 a	0.123 d		0.120a	
Interference SA × Pseudomonas fluorescens	0	0.043 j	0.058 i	0.070 h	0.057 i			0.057c
	50 ppm	0.070 h	0.216 b	0.160 d	0.095 G			0.135a
	100 ppm	0.073 h	0.110 f	0.225 a	0.098 G			0.12b
	150 ppm	0.070 h	0.115 ef	0.121 e	0.200 c			0.12b
Effect of Pseudomonas fluorescens		0.064 d	0.125 b	0.144 a	0.112 C			
* Mean values followed by the same letter are not significantly different according to Duncan’s multiple range test (P < 0.05).								

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test ($P < 0.05$).

The initial stage, the effect of interference between varieties and concentrations of salicylic acid showed that the concentration 100, 50 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (0.147%), While the values decreased significantly at the concentration of (150 ppm), for the second variety of wheat Abaa 99, the highest value is 50 ppm (0.123 %). and lower one at (0.052 %).

with reference to the interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the highest values (0.225%) compared with other concentration, Followed by the value of SA1+PF1 (0.216%). The values gradually decrease from (0.200%), while the lowest value is (0.043%).

Actually, The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (0.135 %) in a 50 ppm concentration .

On the other hand , Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values (0.157%) in variety Abu-graib , but that the lowest value (0.063 %) in Abaa 99 at the concentration control .

In this case, the data of the Effect of varieties show higher value (0.120 %) That's for variety Abu-graib and lower at (0.102%) That's for variety Abaa 99 .

At last, The results for that the highest values for *Pseudomonas fluorescens* effect it was (0.144%) in 10^6 cfu./ml and lower on (0.064 %) .

Mineral nutrients are necessary for plant and microorganism growth and development, as they play a role in the regulation of a variety of physiological and biochemical processes.

Each plant's physiological and biochemical processes are affected differently by each factor (positively or negatively). Salicylic acid, as a phytohormone, influences the amounts of anions (positive and negative) charge in the herb, as well as the ions calculated (N^+ , P^{-2} , K^+ , Mg, and Ca^{+2}) in this study. All the mineral elements are common in one thing are increasing at (SA2+PF2) their values (1.190, 0.518, 2.370, 1.023, 0.236) % respectively, for that reason the highest value at the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (10.18 %) for variety Abu-graib was better .

Pseudomonas spp. are effective nitrogen accumulation . Denitrification is a capability that certain strains have (Forbisher *et al.*, 1974) Phosphate solubilization was strongest when *P. fluorescens* was inoculated at pH 5. Maximum phosphate

solubilization was observed in the inoculant for maximizing plant growth at this pH (Yadav, Yadav, and Vashistha, 2016).

P solubility was found to be proportional to the amount of organic acids formed. The study's significance and impact: *Pseudomonas fluorescens* possessed a variety of traits linked to plant growth promotion. As a result, *P. fluorescens* may be a viable candidate for biofertilizer or biocontrol agent production. the bacterium's potential as a soil modification for increasing soil P availability or as a bio fertilizer There have been several experiments on P solubilization by *Ps. fluorescens* strains and the mechanism of P solubilization.

were looked into the capacity of *Ps. fluorescens* to solubilize insoluble P in vitro using two different mechanisms: Proton extrusion and organic acid production through ammonium assimilation. *P. fluorescens* was ability to produce plant growth-promoting activities such as indoleacetic acid (IAA), siderophore, hydrogen cyanide (HCN), and enzyme activities such as aspectinase, lipase, and protease.

The bacterium's potential as a soil modification for increasing soil P availability or as a bio fertilizer ,There have been several experiments on P solubilization by *P. fluorescens* strains and the mechanism of P solubilization (Park, Lee and Son, 2009) .The reason for this result, may be return to effect of *P. fluorescens* and SA concentrations of biomass and more efficiency for root system to absorptive these ions from the soil solution, look to table (4.6) ,(4.6) and (4.4).

Because of the accelerated growth and differentiation of the roots, as well as the output of stomata, *P. fluorescens* and salicylic acid improved the activity of the root system, resulting in an increase in element absorption by the roots and leaves. In accordance to controlling the processes of transpiration and respiration, as well as the

pulling of ascending sap, water evaporation, and element aggregation in the leaves, it also induces changes in the electrical membranes to promote element absorption.

In accordance to its regulatory function, salicylic acid stimulates the development of hormones or prevents hormone degradation within the plant, raising the market for major elements and their material (Katz , *et al.*, 2002; karlidag , *et al.*, 2009) .

4-2-2-16 : Effect of *Pseudomonas fluorescens* and salicylic acid in the protein :

Pseudomonas fluorescens and salicylic acid effected on the protein in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.24). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (7.427 mg/g) , compared with the control .

Accordingly , there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (5.721 mg/g) while the lowest value is at (0.969 mg/g) .otherwise , there are significant differences between them at ($p \leq 0.05$) because they took the differences letters .

Table (4.24) Effect of *Pseudomonas fluorescens* and salicylic acid in (protein)mg/g between the two varieties of *Triticum aestivum* .L.

Triticum aestivum .L	SA	<i>Pseudomonas fluorescens</i>				Interferen ce varieties × SA	Effect of varieties	Effect of SA
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml			
Abaa 99	0	0.969 m	1.750 k	1.770 k	1.770 k	1.567 f		
	50 ppm	2.270 j	4.031 e	3.145 g	2.729 hi	3.046 c		
	100 ppm	2.208 j	2.645 hi	5.721 d	2.666 Hi	2.739 d		
	150 ppm	2.125 j	2.604 hi	2.687 hi	3.541 f	2.739 d		
Abu- Graib	0	1.384 l	2.145 j	2.125 j	1.854 K	1.869 f		
	50 ppm	2.541 j	6.918 b	3.437 f	2.770 H	3.927 a		
	100 ppm	2.583 hi	3.000 g	7.427 a	3.041 G	4.015 a		
	150 ppm	2.604 hi	3.041 g	3.000 g	4.646 d	3.328 b		
Interferen ce varieties × <i>Pseudomonas</i> <i>fluorescens</i>	Abaa 99	1.895 g	2.760 e	3.348 c	2.677 e		2.670 b	
	Abu- graib	2.270 f	3.786 b	4.000 a	3.083 d		3.285 a	
Interferen ce SA × <i>Pseudomonas</i> <i>fluorescens</i>	0	1.166 i	1.947 g	1.947 g	1.812 H			1.718 d
	50 ppm	2.406 f	5.500 b	3.291 d	2.750 e			3.486 b
	100 ppm	2.395 f	2.822 e	6.614 a	2.854 e			3.671 a
	150 ppm	2.364 f	2.822 e	2.843 e	4.104 c			3.033 b
Effect of <i>Pseudomonas fluorescens</i>		2.083 d	3.273 b	3.674 a	2.880 c			

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).

First off , the of interference between varieties and concentrations of salicylic acid showed that the concentration 100 ,50 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (4.015 mg/g ,3.927 mg/g) ,While the values decreased significantly at the concentration of (150 ppm), for the second variety of wheat Abaa 99 , the highest value is 100 ppm ,150 ppm . and lower one at (1.567 mg/g) .

As regards the interaction between SA and *Pseudomonas fluorescens* were noted that the SA2+PF2 has the highest values (6.614 mg/g) compared with other concentration , Followed by the value of SA1+PF1 (5.500 mg/g) . The values gradually decrease from (4.104 mg/g) , while the lowest value is (1.166 mg/g) .

Actually,The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (3.671 mg/g) in a 100 ppm concentration .

On the other hand ,Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values(4.000 mg/g) in variety Abu-graib , but that the lowest value(1.895 mg/g) in Abaa 99 at the concentration control .

Currently , the data of the Effect of varieties show higher value(3.285 mg/g) That's for variety Abu-graib and lower at (2.670 mg/g) That's for variety Abaa 99 .

Eventually, The results for that the highest values for *Pseudomonas fluorescens* effect it was (3.674 mg/g) in 10^6 cfu./ml and lower on(2.083 mg/g) .

Proteins is very significant of the cell, because in the whole organism life protein molecule is possible to make of it hormone or took another route to manufacture enzyme, which may be study to generate amino acid in some form protein is important in the cell plant life, so any material that improves protein is a favorite application on the plant Ps. According to the data in table, *p. fluorescens* and SA had an impact on rising protein content (4.24), particularly at the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (7.427 mg/g) ,, on the other side when increasing of *P. fluorescens* and SA concentrations in combination or alone increase protein content, implying that there is a favorable association between a high degree of SA concentration and protein content, suggesting that salicylic acid may be used as an internal phytohormone again. The foliar protein content in the leaves of plants treated with SA and Placed was also marginally higher *P. fluorescens*. *P. fluorescens* itself, as well as in combination with PGRs and co-treatment, significantly increased the leaf protein concentration of the susceptible cultivar. when used in conjunction with PGRs, PGPR alone, or their consortium, or PGPR consortium, resulted in a greater increase in leaf protein

concentration in the responsive variety than in the resistant variety. (Khan, Bano, and Babar ,2019) .

4-2-3 : Effect of *Pseudomonas fluorescens* and salicylic acid in Yield

Parameters :

4-2-2-1 : Effect of *Pseudomonas fluorescens* and salicylic acid in the hundred grains weighed:

Pseudomonas fluorescens and salicylic acid effected on the hundred grains weighed in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.25). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (3.104g) , compared with the control

For that reason, there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (3.088g) while the lowest value is at(2.455g) .otherwise , there are significant differences between them at ($p \leq 0.05$) because they took the differences letters .

Table (4.25) Effect of *Pseudomonas fluorescens* and salicylic acid in A hundred grains weighed (g) between the two varieties of *Triticum aestivum* .L.

Triticum aestivum L m	SA	Pseudomonas fluorescens				enceInterf er varieties × SA	Effect of varieties	Effect of SA		
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml					
Abaa 99	0	2.455 q	2.632 o	2.758 n	2.548 p	2.598 f				
	50 ppm	2.812 kl	3.080 c	3.054 d	2.873 g	2.955 d				
	100 ppm	2.839 j	3.011 f	3.088 bc	3.003 f	2.985 c				
	150 ppm	2.822 k	3.028 e	3.031 e	3.075 c	2.989 c				
Abu- graib	0	2.439 r	2.772 m	2.802 l	2.762 mn	2.694 e				
	50 ppm	2.844 ji	3.095 ab	3.074 c	3.034 e	3.012 b				
	100 ppm	2.855 hi	3.057 d	3.104 a	3.078 c	3.023 a				
	150 ppm	2.857 h	3.052 d	3.055 d	3.081 c	3.011 b				
Interferenc e varieties × Pseudomon as fluorescens	Abaa 99	2.732 g	2.938 d	2.983 c	2.874 e		2.935 b			
	Abu- graib	2.749 f	2.994 b	3.008 a	2.989 bc		2.935 a			
Interferen ce SA × Pseudom onas fluoresce ns	0	2.447 k	2.702 i	2.780 h	2.655 j			2.646 c		
	50 ppm	2.828 g	3.087 a	3.064 c	2.954 e			2.983 b		
	100 ppm	2.847 f	3.034 d	3.096 a	3.040 d			3.004 a		
	150 ppm	3.034 d	3.040 d	3.043 d	3.078 b			3.000 a		
Effect of Pseudomonas fluorescens		2.740 d	2.966 b	2.995 a	2.932 c					
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).										

* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test ($P < 0.05$).

Begin with , the of interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (3.023g) ,While the values decreased significantly at the concentration of (50 ppm), for the second variety of wheat Abaa 99 , the highest value is 100 ppm ,150 ppm . and lower one at (2.598g) .

Concerning the interaction between SA and *Pseudomonas fluorescens* were noted that the (SA2+PF2) has the highest values (3.096g) compared with other concentration , Followed by the value of SA1+PF1 (3.087g) . The values gradually decrease from (3.078g) , while the lowest value is (2.447g) .

The effect of the 4 SA concentrations was found to be substantially different from the control at ($p \leq 0.05$), with the maximum value (3.004 g) , (3.000 g) in a 100 ppm , 50ppm concentration respectively that took same letters .

On the other hand ,Interference varieties and *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values(3.008 g) in variety Abu-graib , but that the lowest value(2.732 g) in Abaa 99 at the concentration control .

Here, the data of the Effect of varieties show higher value(2.935 g) That's for variety Abu-graib and lower at (2.935g) That's for variety Abaa 99 .

At the final point, The results for that the highest values for *Pseudomonas fluorescens* effect it was 2.995 g) in 10^6 cfu./ml and lower on(2.740g) .

However, according our findings, exogenous application of *Pseudomonas fluorescens* and SA can improve hundred grains weighed , especially when combined. This is consistent with the findings of both (Elekhtyar, 2015) , (Mercado-Blanco *et al.*, 2016) , (Shanmugaiah *et al.*, 2009) Where he found the effect of *Pseudomonas fluorescens* increases the grains weighed and (Noreen *et al.*, 2017) , (Tucuch-Haas *et al.*, 2017) , (Matysiak *et al.*, 2020) Where he found the effect of SA increases the grains weighed.

4-2-2-2 : Effect of *Pseudomonas fluorescens* and salicylic acid in the number of tillers/plant :

Pseudomonas fluorescens and salicylic acid where effected on the number of tillers in *Triticum aestivum* .L varieties (Abaa 99 , Abu-graib) can be seen in Table (4.26). The highest concentration is below ($p \leq 0.05$) for the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (3.875) , compared with the control , Whence , there are substantial variations between them at ($p \leq 0.05$), and they use different letters. The similar result reported to variety Abaa 99 it also have higher value in the concentration *P. fluorescens* (10^6) c.f.u./ml (FP2) for a SA concentration of 100 ppm (SA2)), which was (3.625) while the lowest value is

at(1.750) .otherwise , there are significant differences between them at ($p \leq 0.05$) because they took the differences letters.

let's clarify , the interference between varieties and concentrations of salicylic acid showed that the concentration 100 ppm takes the highest values significantly at ($p \leq 0.05$) compared to other concentrations, especially in variety Abu-graib, (3.000) ,While the values decreased significantly at the concentration of (50 ppm), for the second variety of wheat Abaa 99 , the highest value is 50 ppm . and lower one at (1.844) .As for the interaction between SA and *Pseudomonas fluorescens* were noted that the (SA2+PF2) has the highest values (3.750) compared with other concentration , Followed by the value of SA1+PF1 (3.563) . The values gradually decrease from (3.375) , while the lowest value is (1.750) .

Actually,The effect of the 4 SA concentrations was found to be substantially different from the control at , with the maximum value (2.875) , in a 50ppm concentration , On the other hand , Interference varieties $\times$ *Pseudomonas fluorescens* indicate a 10^6 cfu./ml they have the highest values(2.969) in variety Abu-graib , but that the lowest value(2.125) in Abaa 99 at the concentration control .Currently , the data of the Effect of varieties show higher value(2.719) That's for variety Abu-graib and lower at (2.500) That's for variety Abaa 99 , Finally , The results for that the highest values for *Pseudomonas fluorescens* effect it was (2.906) in 10^6 cfu./ml and lower on(2.172) .

Table (4.26) Effect of *Pseudomonas fluorescens* and salicylic acid in No. of tillers/plant between the two varieties of *Triticum aestivum* .L.

Triticu m aestivu .L m	SA	<i>Pseudomonas fluorescens</i>				Interfere nce varieties × SA	Effect of varieties	Effect of SA		
		0	10 ⁵ c.f.u./ml	10 ⁶ c.f.u./ml	10 ⁷ c.f.u./ml					
<i>Abaa</i> 99	0	1.750 q	1.875 p	1.875 p	1.875 p	1.844 h				
	50 ppm	2.250 m	3.375 e	3.125 g	2.375 l	2.781 d				
	100 ppm	2.250 m	2.375 l	3.625 c	2.375 l	2.656 f				
	150 ppm	2.250 m	2.625 j	2.750 i	3.250 f	2.719 e				
<i>Abu- graib</i>	0	1.750 q	2.125 n	2.000 o	2.125 n	2.000 g				
	50 ppm	2.250 m	3.750 b	3.125 g	2.750 i	2.969 b				
	100 ppm	2.500 k	2.875 h	3.875 a	2.750 i	3.000 a				
	150 ppm	2.375 l	2.875 h	2.875 h	3.500 d	2.906 c				
Interferenc e varieties × <i>Pseudomo nas fluorescens</i>	<i>Abaa</i> 99	2.125 g	2.563 e	2.844 c	2.469 f		2.500 b			
	<i>Abu- graib</i>	2.219 g	2.906 b	2.969 a	2.781 d		2.719 a			
Interferen ce SA × <i>Pseudom onas fluoresce ns</i>	0	1.750 n	2.000 l	1.938 m	2.000 l				1.922 d	
	50 ppm	2.250 k	3.563 b	3.125 d	2.563 h				2.875 a	
	100 ppm	2.375i	2.625 g	3.750 a	2.563 h				2.828 b	
	150 ppm	2.313 j	2.750 f	2.813 e	3.375 c				2.813 c	
Effect of <i>Pseudomonas fluorescens</i>		2.172 d	2.839 f	2.906 a	2.625 c					
* Mean values followed by the same letter are not significantly different according to Duncan's multiple range test (P < 0.05).										

However, according our findings, exogenous application of *Pseudomonas fluorescens* and SA can improve number of tillers/plant , especially when combined. This is consistent with the findings of both (Sharma, Shankhdhar and Shankhdhar, 2014)Where the effect of *Pseudomonas fluorescens* increases the number of tillers/plant was found and (Noreen *et al.*, 2017) Where the effect of SA increases the number of tillers/plant was found.

5. Conclusions

1- The synergistic effect for *Pseudomonas fluorescens* and salicylic acid in some physiological characteristics of wheat plant (*Triticum aestivum*) may be more for increased vegetative growth aspects, and the physiological parameters.

2- The combined treatment of all three concentrations was effective and (SA2+PF2) was more effective in both the varieties than any other treatment. There are varying responses for varieties.

3- The addition of the bacterial inoculation and salicylic acid improved the growth parameters, which was positively reflected on the physiological parameters, and with low concentrations, which reflected positively on the parameters of the yield.

6.Recommendations :

1. Application of *Pseudomonas flourescens* and salicylic acid for its positive effect on studied traits at concentrations below than (100 ppm, 10^6 cfu/ml) in later studies.
2. Use another monocot and dicot plant treated with *Pseudomonas flourescens* and salicylic acid, and recognizing changes in these plants for better or worse.
3. Molecular study of (*Triticum aestivum*) is treated with *Pseudomonas flourescens* and salicylic acid and recognizing whatever happening of geneing map as response to treating .
4. More research needs to be done with different PGR concentrations coupled with different PGPR consortiums under various stresses.
5. It can be used in other Iraqi soils, particularly these soils, where salt stress and high temperatures are present.
6. I recommend a study in the field and its effect on the crop and its difference from the study of the greenhouse.
7. Study of the effect of SA and *Pseudomonas flourescens* on antioxidant enzymes .

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المخلص

اجريت هذه الدراسة في البيت الزجاجي التابع لجامعة المثنى ، كلية العلوم ، قسم علوم الحياة خلال موسم النمو في ديسمبر 2020-2021. استخدمت تراكيزات متنوعة من حامض الساليسيك وهي (50،0 ، 100 ، 150) جزء من المليون و *pseudomonas fluorescens* عند (10^5 , 10^6 , 10^7) وحدة مستعمرة مكونه/ ملي لتر على النمو وبعض الجوانب الفسيولوجية لصنفين من نبات الحنطة (*Triticum aestivum* .L.) وهما (ابو غريب واباء 99). حللت النتائج احصائيا طبقا للتصميم العشوائي الكامل (C.R.D) بثلاثة مكررات ، وأظهرت النتائج التأثير معنويا لفعل التازر *pseudomonas fluorescens* و حامض الساليسيك عند التركيز *P. fluorescens* (10^6) وحدة مستعمرة مكونه / ملي لتر (PF2) و SA عند تركيز 100 ppm (SA2) وتفقو الصنف ابو غريب على الصنف الحنطة الآخر اباء 99 في صفات النمو مثل مساحة الورقة (26.42) سم² ، وزن الخضري الجاف ، الجذر (1.239 ، 0.610) جم ، ارتفاع النبات (64.50) سم ، طول الجذر (60.13) سم ، الوزن الطري للساق والجذر (4.55 ، 1.20) جم على التوالي ، والمعايير الفسيولوجية مثل الكلوروفيل a ، b ، b/a ، $b+a$ والكاروتين بجانب العوامل الأخرى مثل المحتوى المائي النسبي (90.63%) ، ثبات الغشاء (10.18%) ، محتوى الأيونات من النيتروجين (1.190%) البوتاسيوم (2.370%) مغنيسيوم (1.023%) كالسيوم (0.236%) فوسفات (0.518) كربوهيدرات (55.553 مجم / جم) بروتين (7.427 مجم / جم) اما بالنسبة نفاذية أيون مثل Na^+ ، K^+ فان حمض الساليسيك له تأثيرات إيجابية في تقليل النفاذية. من K^+ و Na^+ أيونات (8.75%) بينما (SA1+PF1) يقلل من نفاذية أيونات الصوديوم (17.383%). كما ازدادت مؤشرات الحاصل مثل وزن مائة حبة (3.104 جم) ، عدد الاشطاء / نبات (3.875) قطعاً وفي ضوء النتائج المستحصله فان الإضافة حسنت مجمل صفات النمو فانعكس ايجابا على المعايير الفسيولوجية لنبات وفضلا عن صفات الحاصل .



جمهورية العراق
وزارة التعليم العالي والبحث العلمي
جامعة المثنى
كلية العلوم
قسم علوم الحياة

تأثير بكتريا *Pseudomonas fluorescens* وحامض السالسيلك وتأثيرهما التآزري في النمو والانتاج وبعض الخصائص الفسيولوجية لصنفين من نبات الحنطة

رسالة مقدمة كجزء من متطلبات نيل درجة الماجستير في علوم الحياة

من قبل

حسين محسن حميد

بكالوريوس علوم الحياة ٢٠١٠

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