Comparison between amino acids and chemical fertilizers in terms of their effect on growth and yield traits of peas (*Pisum sativum* L.)

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Abstract:

A field experiment was conducted during 2024-2025 agricultural season in the fields of the Department of Plant Production Techniques/Agricultural Technical College/ Northern Technical University. study aimed to compare organic fertilization using amino acid fertilization on the one hand and chemical fertilization on other hand using balanced NPK compound fertilizer, as well as mixing organic and chemical fertilization with the aim of reducing chemical fertilizers due to their harmful effect on the environment and human health. experiment was conducted using a randomized complete block design (R.C.B.D), with 12 experimental units. the experiment included one factor: four sprays of fertilizer (no fertilizer for comparison purposes, N.P.K chemical fertilizer, organic fertilizer with amino acids, and a treatment mixing chemical fertilizer and amino acids 50:50). plants were sprayed twice, first time at the 3-5 true leaf stage, and second time 15 days after the first spray. results showed that the mixed treatment was superior to the other treatments in all traits, plant height, number of branches per plant, pod length, number of seeds per pod, weight of 100 seeds, and seed yield kg. dunum^{-1} and biological yield kg. dunum^{-1}, which reached values of 88.45 cm 7, 12.78 cm, 11, 17.89 g, 387.50 kg. dunum^{-1} and 83625 kg. dunum^{-1}, respectively.

Keywords— Amino acids, peas, chemical fertilizer.

INTRODUCTION

Scientific name for peas is *Pisum sativum* L., and English name is Pea. It belongs to legume family Fabaceae. Peas are considered an important crop in legume family. They are grown for their fresh green seeds, tender green pods, and dried seeds or vegetative parts [1]. Peas are economically important, ranking third among vegetable crops in terms of nutritional value [2]. Peas are grown for dry seed production in areas with a relatively cool growing season, free from disease and insect infestations, and free from spring frosts. cultivated area in Iraq is about 12 dunum, except for Kurdistan region, with an average productivity of 1.500 kg. dunum^{-1} [25]. There are several ways to improve growth and increase crop productivity, including proper agricultural practices and fertilization. Fertilizer use is a crucial factor in growth and productivity of peas, such as increasing fruit set and yield, accelerating ripening, and increasing the number of branches and pods. In recent years, there has been a global trend toward the use of seaweed extracts, a form of organic farming [24]. This is a modern technique for plant nutrition, which has a positive impact on improving plant growth and increasing productivity. Farmers use mineral fertilizers (NPK) primarily to increase crop yields and sustainability. Environmental and soil-related factors adversely affect nutrients in these fertilizers, leading to phosphorus fixation. Nitrogen leaching, evaporation, and excessive

fertilizer use also lead to a decrease in soil microflora spray and reduced nitrogen fixation [3]. Therefore, it is necessary to choose other methods to provide nutrients needed for crop productivity while maintaining an excellent and environmentally friendly soil structure [4],[5]. It is also important to combine these two fertilizers (Chemical and organic) to reduce chemical fertilizers, which are a source of agricultural environmental pollution. Organic fertilizers can improve biological, chemical, and physical properties of soil, enhancing its structure [6]. However, the continued and excessive use of inorganic fertilizers has negative effects, leading to soil degradation with the decline of organic matter. Environmentally friendly biological agents and organic fertilizers can also help reduce organic waste in environment [7], [23]. Amino acids are bio-stimulants that provide plants with energy needed to replace losses resulting from respiration and decomposition. They are characterized by being colorless ionic compounds that dissolve in cold and hot water and alcohol to varying degrees, and they have a high melting point because they are hybrid ions. Amino acids are found in plants either free or combined to form proteins and peptide compounds, but the free form It is the most common, as it breaks down small bonds, making amino acids free, single, and easily penetrated [8]. Amino acids play a vital role in many biological processes, whether free or as part of proteins. Therefore, their importance and effectiveness lie in the stages of plant growth. They contribute to increasing the cells' ability to absorb water and dissolved nutrients from the growth medium, thereby increasing vegetative growth. They also increase the synthesis of proteins that contribute to the multiple functions of plant metabolism. It enhances the rate of carbon uptake, which leads to an increase in total dry matter, which is reflected in depletion and production [9]. [10]. confirmed these results, Amino acids play an important role in many biological processes, as they are part of proteins. Their importance and effectiveness lie in all stages of plant growth, as they contribute to increasing the cells' ability to absorb water and nutrients from the soil and increasing vegetative growth [10]. Adding amino acids to plants increases quality and efficiency and has direct and indirect effects on physiological functions. [11]. demonstrated that sorghum treated with amino acids significantly improved growth traits, yield, and their components. results indicated that foliar fertilization of some crops with amino acids resulted in an increase in plant height by 23.29%, which led to obtaining the highest degree of photosynthesis and an increase in grain yield [12]. These results were confirmed by results of [10]. who indicated that spraying a mixture of amino acids and nitrogen fertilizers at spray of (166, 214, and 262 kg N. ha^{-1}) on wheat crop plants resulted in an increase in plant height by 23.29%, as well as chlorophyll concentration, which led to highest degree of photosynthesis and an increase in grain yield by 7.50% and straw yield by 10.90%. in general, given their important role in metabolic and biochemical processes of plant cells. In addition to complete nutrient content, use of compound fertilizers is more uniform and simpler in fertilizer distribution, as farmers no longer need to mix different types of fertilizers as they do when using individual fertilizers [13]. Use of compound fertilizers containing N. P. K is expected to increase crop productivity [14]. study aims to reduce use of chemical fertilizers and replace them with organic fertilizers such as amino acids, even if it is half amount.

Materials and Methods

A simple experiment was carried out in fields of Department of Plant Production Technologies/ College of Agricultural Technology/ Mosul, sowing date 5/11/2024. Four fertilization treatments on a local variety of pea crop were used in this study to compare them. soil of field was loamy and was tillage .and divided into equal experimental units, where area of experimental unit was 1 m^2. Rainwater and supplemental irrigation were used as needed. Planting was done in rows, with a distance of 25 cm between rows and 25 cm between plants. experiment included one factor including four spray control treatment without fertilization, fertilization with amino acids only (200 ml per 100 liters of water), chemical fertilization N.P.K only (12 kg. $dunum^{-1}$)- mixing amino acid fertilization and chemical fertilization (50:50). experiment was sprayed with fertilizer one month after germination. Vegetative growth samples were taken at crop maturity before drying, and yield and yield components samples were taken after maturity and drying, experiment was harvested on 27/4/2025. experiment was carried out using a randomized complete block design (R.C.B.D) with one factor that included four spray of fertilization, with three replicates. experiment consisted of 12 experimental units, each with an area of 1 m^2, in which fertilizer spray were distributed randomly. Traits studied: Plant height (cm). Five plants were randomly measured from each experimental unit, from soil surface to the end of the main branch. Number of branches. $Plant^{-1}$ number of branches was calculated for three plants from median lines, and their average was taken. Pod length (cm). Pod length was calculated as average of five pods randomly selected from plants in midlines. Number of seeds per pod. Calculated from average of five plants randomly chosen from the midlines. Weight of 100 seeds (g). was calculated using an electronic balance, where the average weight of samples from each experimental unit was taken. Seed yield (kg. $dunum^{-1}$). Grain yield was calculated by harvesting one square meter, drying the seeds, weighing them, and then converting them to dunums [15]. Biological yield (kg. $dunum^{-1}$) This is weight of total dry matter (seeds + straw) after harvesting, drying, weighing, and converting it to dunums. Harvest index (%) harvest index was calculated by dividing seed yield by the biological yield, multiplied by 100 [15].

Results and discussion:

Plant length. (cm): Table (1) indicates a significant effect of different fertilizer types and their combinations on the studied traits. highest significant value for plant height was obtained when mixing N.P.K chemical fertilizer with amino acids, reaching 88.45 cm, compared to control treatment and remaining treatments. This is perhaps due to the availability of nutrients, including major nutrients such as phosphorus and potassium, as well as minor nutrients found in organic fertilizers and amino acids, which leads to increased stem cell division and elongation. this is consistent with the findings of [23]. Number of branches per plant: highest significant value was achieved for number of branches trait when treated with N.P.K chemical fertilizer and when mixed with organic and chemical fertilizer, reaching 7.33 and 7 branches per plant, respectively. There was no significant difference between the two values. reason for this superiority may be attributed to increased availability of nutrients, which prompted plants to produce largest

number of green branches in treatments mentioned above. This is consistent with [17]. Pod length in cm: results indicate that the treatment mixing organic and chemical fertilizers significantly outperformed the control treatment in pod length, while there was no significant superiority over the other treatments. This may be due to the availability of the necessary nutrients. Which leads to stimulating growth, division and elongation of plant cells, as well as leading to a balance in vital processes within plant, which leads to an increase in efficiency of photosynthesis, which is positively reflected in all growth and yield traits, and this is consistent with [18]. Number of seeds. Pod^{-1}: results obtained showed that amino acid treatments alone and when mixed with chemical fertilizer significantly outperformed other treatments in number of seeds. Pod^{-1}, reaching 10.67 and 11 seeds, respectively. This may be due to availability of important plant nutrients in amino acids alone and when mixed with chemical fertilizers, which positively reflects on strength of plant's vegetative growth and efficiency of photosynthesis, which in turn leads to an increase in number of seeds in pod. This is consistent with [19]. weight 100 seed (g): results indicate a significant superiority of 100-seed weight when mixing amino acids with chemical fertilizer over other treatments, reaching 17.89 g. This is likely due to increased concentration of nutrients task for plant growth increased efficiency of photosynthesis, which led to increased deposition of nutrients in estuaries (seeds), making them fuller and heavier than other treatments, which is consistent with [18]. Seed yield (kg. $dunum^{-1}$): Seed yields significantly outperformed other treatments used in the experiment, which amounted to 387.50 kg. $dunum^{-1}$, when peas were treated with a mixture of organic fertilizer consisting of amino acids and chemical fertilizer consisting of N.P.K This may be due to availability of all necessary nutrients of phosphorus, potassium and amino acids that contain many trace elements and other nutrients, as fertilizer mixture was integrated, which was positively reflected in raising efficiency of photosynthesis, and the evidence for this is the superiority of In all vegetative growth traits, yield of the plant, number of branches, length of pod, number of seeds per pod, and weight of 100 seeds, final result was an increase in the amount of yield per unit area, which is consistent with [20]. Biological yield. kg. $dunum^{-1}$. results indicate a significant difference between the fertilizer treatments in their impact on biological yield trait. treatment mixing amino acids with chemical fertilizer recorded highest significant values for this trait, reaching 836.25 kg. $dunum^{-1}$, compared to the other treatments, this may be due to the superiority of all other traits when treating with mixed fertilizers due to supplying plant with all its nutrient needs, which led to an increase in plant length, number of branches, number of seeds.

Pod^{-1}, weight of 100 seeds and yield, which led to an increase in biological yield and its moral superiority, and this is consistent with [20] Harvest Index%: From the results obtained, note that there are no significant differences between the treatments used in the experiment.

Table 1. Effect of fertilizer quality on growth traits and yield of peas.

Fertilization	Studied traits							
	Plant length. cm	Number of branches	pod length. cm	Number seeds. Pod^{-1}	Weight 100 seeds. g	Seed yield. kg. dunum^{-1}	Biological yield. kg. dunum^{-1}	Harvest Index%
Control	77.03 c	4.67 c	9.51b	8.00b	13.66c	270.83c	535.00c	50.59a
N.P. K	83.26 b	7.33 a	11.15ab	8.00b	16.92b	296.67bc	608.33b	48.82a
amino acids	82.14 b	5.67 bc	11.04ab	10.67a	15.65b	320.83b	649.17b	49.74a
N.P.K + amino acids	88.45 a	7.00 a	12.78a	11.00a	17.89a	387.50a	836.25a	46.60a

Values followed by identical letters within a column are not significantly different from each other at 0.05% probability level

CONCLUSION:

I. Mixing chemical fertilization (P.K) with organic fertilization (amino acids) provided the necessary nutritional requirements for the pea crop, which led to the superiority of all studied traits.

II. On other side, it is possible to reduce chemical fertilization, which is considered one of the agricultural pollutants to the environment

III. .

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