African J. Biol. Sci., 19 (2): 87-99(2023)
ISSN 1687-4870 e- ISSN 2314-5501 (online)
www.ajbs.journals.ekb.eg E.mail: aasdjournal@yahoo.com

Response faba bean cv. "Giza 3" to folair application of GA_3 and tryptophan

Ibrahim F.M. Ahmed
Faculty of Agriculture, Bani Walid - University of Bani Walid, Libya

Received: October 3, 2023; Accepted: December 11, 2023; Available online: : December 11, 2023
Doi: 10.21608/AJBS.2023.326820

ABSTRACT

A field experiment was conducted in Sof Al-Jin Farm in Bani Walid, Libya, during the agricultural winter season 2022/2023 to study the effect of spray of GA^3 at 50, 100, 150 mg/l and tryptophan at 100, 200, 300 mg/l and control treatment (tap water) on vegetative growth, yield and yield components and chemical composition of faba bean cv. "Giza 3". The experiment was applied according to Randomized Complete Block Design (RCBD) with three replicates for each treatment. The results showed that the increasing of the concentration of tryptophan up to 300 mg/l led to increase some vegetative growth (plant height, number of branches/ plant, shoot length, shoot dry weight, total chlorophyll, leaf area), yield and yield components (pod weight, pod length, number of pods/plant, number of seeds/pod, 100 seeds weigh seed yield, biological yield) and chemical composition (nitrogen, phosphorus, potassium, protein and tital carbohydrates percentages), followed by folair application of GA_3 at 150 mg/l, as compared to control treatment (spray tap water). In addition the data revealed that, foliar spraying of either tryptophan or GA_3 led to significant increases in faba bean vegetative growth, yield and yield components as well as significant improvement of the nutritional status of faba bean plants and seeds nutrient, carbohydrates and protein content. The results showed that foliar application of tryptophan was more effective than GA_3 in concern of growth, yield and yield components plant and seeds chemical constituents and nutritional status especially at the high concentration (300 mg/l tryptophan and 150 tryptophan GA_3).

Keywords: Faba beans (*Vicia faba*), Gibberellic acid, Amino acid, yield, fruit quality, chemical compositions.

INTRODUCTION

Faba bean is widely cultivated as the fourth most vital cool-season legume crop, grown globally under diverse cropping conditions and environments (Villacampa *et al.,* 2020). It is grown in more than 60 countries worldwide viz., East and North Africa, Southern Europe, West, and South Asia, South and North America, and Australia etc. China is the main producer of faba bean seed followed by Ethiopia and Australia (37%, 18% and 9%) (Dhull *et al.,* 2022). This plant is widely used for human and animal feed in many countries because of its high contents of organic materials (e.g., proteins, essential amino acids, thiamin, folic acid, and tocopherol) and minerals (e.g., iron and zinc) (Maalouf *et al.,* 2020; Maalouf *et al.,* 2022). Legumes, or pulses, are flowering plants that usually form pods that dehisce longitudinally with seeds inside. The family of legumes is called Leguminosae or Fabaceae, the third largest flowering plant family, with over 750 genera and 19,000 species (Tiwari *et al.,* 2020).

Faba bean is also used for animal feeding and green manure (Koç *et al*., 2018; Martineau-Côté *et al*. 2022). Additionally, it has many agronomic advantages, which may incite production growth in the future by its ability to

biological N_2 fixation, that wisely used to reduce nitrogen fertilizer applications, and that will lead to decrease diseases, and pests in the soil and increase biodiversity (Koç *et al*., 2018).

Pulses are consumed as a low-cost but nutritious food source high in protein content in both the human diet and as animal feed. The global pulse market was nearly US$ 45 billion in 2017 and is anticipated to approach around US$ 76 billion in 2025 (HexaResearch 2019). Among all pulse varieties, the global faba bean market share is projected to grow from US$ 3.18 billion in 2021 to US$ 3.47 billion in 2025. In developing countries, pulses are mainly used for food, while developed countries primarily utilize them for animal feed (Sepngang *et al.* 2020). Faba beans, in particular, are processed as a food source for the Middle East and North Africa, where they are used as a staple element of the population's diet, according to Sepngang *et al.* (2020). The share of faba bean in the human diet has increased with the trend toward plant-based meals. In countries like Spain, faba beans have been harvested fresh and canned for human consumption and have also been incorporated at levels up to 40% in bread (Sepngang *et al.,* 2020).

Adopting sustainable agricultural practices that involve gradually reducing the use of synthetic agrochemicals, increasing the utilization of biowaste-derived substances, and harnessing the biological and genetic potential of crop plants and microbes is a viable strategy to combat rapid environmental degradation, ensure high agricultural productivity, and improve soil health (Basu *et al.,* 2021). In this context, the use of Plant growth-promoting rhizobacteria (PGPR) inoculants in agriculture represents a friendly alternative environment method compared to mineral fertilizers. PGPR promotes crop growth and health in a variety of ways. They've been linked to nitrogen fixation pathways, mineral solubilization (Zn, Fe, P), and increased tolerance to biotic and abiotic stressors (dos Santos *et al.,* 2019; and Ramakrishna *et al.,* 2020).

Gibberellins play an important and major role in plant growth and development such as increasing seed germination and seedling growth, breaking seed dormancy, stimulating root, leaf and stem elongation, stimulating flowering initiation and seed development, and then increasing grain yield. This plant hormone performs many physiological functions, including its responsibility for stimulating seed germination through its control over the synthesis of enzymes necessary for germination (Carrera-Castano *et al.,* 2022). On other hand, gibberellins (GA) as phytohormones play a role in balancing and regulating the growth of internodes (cell elongation) and the growth (shoot growth), development of the leaves, and are involved in regulating dormancy (Fadhil and Almasoody, 2021).

Furthermore, many scientific studies have confirmed that gibberellic acid has clear physiological effects in increasing the percentage of germination for different types of seeds, as well as stimulating the plant to form branches or tillers (Du *et al.,* 2022). Gibberellic acid is one of the growth regulators that stimulate crop growth and has the ability to produce positive effects on yield (Miceli *et al.,* 2019). Many researchers have studied the effect of gibberellic acid on the germination of seeds of many crops, including barley. They found that soaking the seeds with gibberellins had a significant effect on increasing the percentage of seed germination, germination speed, germination vigor, root length, shoot length, and total dry weight of seedlings (Amri *et al.,* 2016).

Gibberellic acid (GA_3) emerges as a crucial plant growth regulator. GA_3 initiates various physiological and developmental processes, including root production, flowering, cell division, maturity, and seed germination. It enhances plants' resilience to

environmental challenges such as salt, cold, drought, and heavy metal stress by modulating antioxidant enzyme activity (Zulfiqar *et al.,* 2019). GA_3 reduces excessive intracellular ROS generated during stress, protecting plants from environmental stressors. Exogenous GA_3 effectively alleviates oxidative stress in wheat induced by salt stress, enhancing soil nutrients, and increasing plant output. Gibberellins regulate various plant growth processes, including seed germination, stem elongation, and flowering (Anwar, 2022).

Amino acids can directly or indirectly influence the physiological activities in plant growth and development such as exogenous application of amino acids have been reported to modulate the growth, production and quality of tomato in plastic greenhouse (Boras *et al.,* 2011).

Amino acid mixtures treatment had a pronounced ameliorative as well as growth promoting effect under both saline and non-saline conditions. This is in line with several reports supporting our obtained results, but obtained on different plant species (ElZohiri and Asfour, 2009).

Amino acid foliar spraying of faba bean plant with different concentrations enhances photosynthetic pigments of plants irrigated either with tap water or saline water. This increase in chlorophyll contents might be due to the availability of higher levels of amino acids to the treated plants as amino acids help to increase the chlorophyll content and this may lead to the increase in different growth criteria (Awad *et al.,* 2007).

The objective of the present work was to assess the effect of foliar application and gibberellic acid and tryptophan on vegetative growth, yield and yield components of faba bean cv. "Giza 3".

MATERIALS AND METHODS

A field experiment was conducted in Sof Al-Jin Farm in Bani Walid, Libya, during the agricultural season 2022/2023.The experiment was arranged in Randomized Completely Block Design (RCBD) design with seven treatments were applied and each treatment comprised of three trees arranged randomly in blocks. The treatments of this experiment could be summarized as follows:

1. Control
2. GA_3 50 mg/l
3. GA_3 100 mg/l
4. GA_3 150 mg/l
5. Tryptophan 100 mg/l
6. Tryptophan 200 mg/l
7. Tryptophan 300 mg/l

- **Data recorded**

A) Vegetative growth:

- Plant height (cm)
- Number of branches/ plant
- Shoot length (cm):
- Shoot dry weight (g/plant)
- Total chlorophll (SPAD)
- Leaf area (cm^2)

B) Yield and yield components

- Pod weight (g)
- Pod length (cm)
- Number of pods/ plant
- Number of seeds/ pod
- 100- seeds weight (g)
- Seed yield(t/ ha)
- Biological yield(t/ ha)

C) Chemical composition

- Nitrogen (N%)
- Posphorus (P %)
- Potassium (K%)
- Protein (%)
- Total Carbohydrates (%)

Statistical analysis:

Results of the measured parameters were subjected to computerized statistical analysis using MSTAT package for analysis of variance (ANOVA) and means of treatments were compared using LSD at 0.05 according to Snedecor and Cochran (1990).

RESULTS AND DISCUSSION

A) Vegetative growth characteristics

Results in Table (1) and Figure (1) illustrated that all vegetative growth parameters of faba bean i.e. plant height, number of branches/ plant, shoot length, shoot dry weight, total chlorophyll, leaf area were significantly affected by folair application of GA_3 at three concentriations (50, 100, 150 mg/l) and tryptophan at three concentriations (100, 200, 300 mg/l) and control treatment (tap water). However, the results showed that folair application of tryptophan at 300 mg/l recorded the higher values of plant height (108.00 cm), number of branches/ plant (7.46), shoot length (160.47 cm), shoot dry weight (149.72 g), total chlorophyll (48.53 SPAD), leaf area (724.98 cm^2), followed by GA_3 at (150 mg/l) plant height (98.23 cm), number of branches/ plant (6.29), shoot length (152.07 cm), shoot dry weight (121.07g), total chlorophyll (45.99 SPAD), leaf area (718.92 cm^2), as compared to the control treatment which recorded the lower of plant height (75.90 cm), number of branches/ plant (3.92), shoot length (122.50 cm), shoot dry weight (52.05g), total chlorophyll (37.04 SPAD), leaf area (445.89 cm^2).

This is due to the role of gibberellin in stimulating the process of the plant elongation, wherever the concentration of gibberellin increased, the plant height was increased. These results agree with Saleh and Abdul (1980). The increase in plant height is due to the effect of gibberellic acid in increasing cell division and enlargement, in adding to stimulating growth and cell expansion (Abdul 1987 and Saleh 1990). Also, the role of gibberellin in stimulating the process of the plant elongation, wherever the concentration of gibberellin increased, the plant height was increased. These results agreed with Saleh and Abdul (1980). The increase in plant height is due to the effect of gibberellic acid in increasing cell division and enlargement, in adding to stimulating growth and cell expansion (Saleh 1990).

Gibberellins play an active role in many phases from the germination of the seed to plant improvement and they are widely used for priming in plant reproduction materials. It has been reported that gibberellic acid (GA_3), one of the plant growth regulators, is both a natural chemical and has the ability to increase the properties of plants such as germination, vegetative growth and grain yield (Ma *et al.,* 2018; Mangena, 2020). (Gupta and Chakrabarty, 2013). Gibberellins provide to break down of cell wall by increasing the endoβ-mannanase enzyme activity in the endosperm. Thus, germination ratio of seeds accelerates thanks to gibberellins (Karakurt *et al.,* 2010)

Exogenous application of polyamine (end product of arginine) promote cell division, cell differentiation and general growth promotion and also help to stabilize membrane and wall properties (Velikova *et al.,* 2000) and protect plant against environmental stress (Mo and Pua, 2002). Moreover, the significant increase in growth parameters of sorghum plants due to foliar application of arginine at the rate of 200 or 300 ppm were recorded by Ahmad *et al.* (2010). The positive effect of amino acids on growth was stated by Goss (1973) who indicated that amino acids can serve as a source of carbon and energy when carbohydrates become deficient in the plant's releasing the ammonia and organic acid form which the amino acid was originally formed. The organic acids then enter Kerb's cycle, to be broken down to release energy through respiration. Thon *et al*. (1981) pointed out that amino acids provide plant cells with an immediately available source of nitrogen, which generally can be taken by the cells more rapidly than inorganic nitrogen. These increases in the above mentioned data due to those amino acids can directly or indirectly influence the physiological

activities of the plant. The regulatory effect of amino acids on growth could be explained by the notion that some amino acids e.g. phenylalanine, ornithine can affect plant growth and development through their influence on gibberellins biosynthesis (Walter and Nawacke, 1978). Also, amino total as a source of amino acids may play an important role in plant metabolism and protein assimilation which is necessary for cell formation and consequently increase in fresh and dry matter. Also, amino acid increase the content and activity of endogenous plant growth regulators, which promote growth of plant organs due to conversion into Indol Acetic Acid (IAA). Auxins promote growth, increase building metabolites, retard senescence, enhance cell division, chlorophyll accumulation and stimulate dry matter production as a result of higher photosynthetic activity, consequently increase translocation and accumulation of micro elements in plant organs as well as building blocks of proteins. These results are in agreement with those reported by Sharief and El-hamady (2017) on broad bean.

Table (1): Effect of folair application of GA_3 and tryptophan on vegetative growth of faba bean cv. "Giza 3" during 2023/2024 season.

Treatment	Plant height (cm)	No. of branches/ plant	Shoot length (cm)	Shoot dry weight (g/plant)	Total chlorophll (SPAD)	Leaf area (cm^2)
Control	75.90	3.92	122.50	52.05	37.04	445.89
GA_3 50 mg/l	83.73	4.55	140.88	69.47	42.60	590.38
GA_3 100 mg/l	93.55	5.20	147.87	86.40	44.72	620.88
GA_3 150 mg/l	98.23	6.29	152.07	121.07	45.99	718.92
Tryptophan 100 mg/l	88.52	5.40	147.53	79.25	44.61	650.17
Tryptophan 200 mg/l	96.25	6.40	155.32	119.88	46.97	680.66
Tryptophan 300 mg/l	108.00	7.46	160.47	149.72	48.53	724.98
$LSD_{(0.05)}$	**8.18**	**0.09**	**15.06**	**18.50**	**4.55**	**34.57**

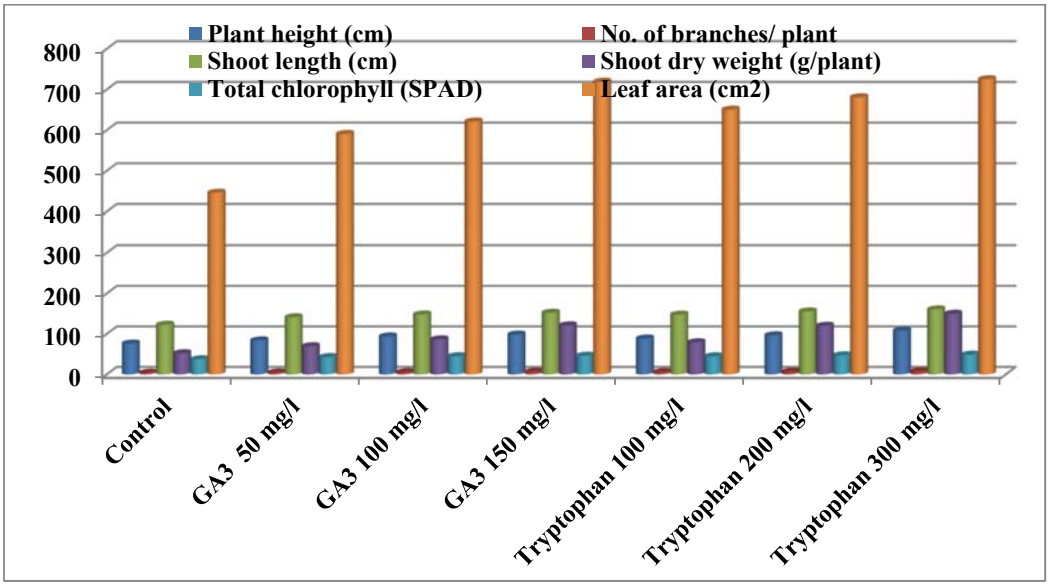

Fig. (1): Effect of folair application of GA_3 and tryptophan on faba bean cv. "Giza 3" during 2022/2023 season.

B) Yield and its components:

Concerning to the effect of some foliar application of GA_3 and tryptophan on yield and yield components of faba bean, results in Tables (2) and Figure (2) showed that these treatments led to a significant increase in all yield and yield components .i.e. pod weight, pod length, number of pods/plant, number of seeds/pod, 100 seeds weigh seed yield, biological yield, which folair application of tryptophan at 300 mg/l recorded the higher values of pod weight (4.37 g), pod length (9.81cm), number of pods/plant (37.62), number of seeds/pod (4.05), 100 seeds weight (100.47g), seed yield (4.82 t/ ha), biological yield (12.87 t/ ha), followed by GA_3 at (150 mg/l) pod weight (4.23 g), pod length (9.47cm), number of pods/plant (33.89), number of seeds/pod (3.94), 100 seeds weight (91.55g), seed yield (4.18 t/ ha), biological yield (12.36 t/ha), as compared to the control treatment which recorded the lower of pod weight (3.21 g), pod length (8.33 cm), number of pods/plant (19.17), number of seeds/pod (3.13), 100 seeds weight (78.51 g), seed yield (3.42 t/ ha), biological yield (8.89 t/ ha).

Also, amino acid increase the content and activity of endogenous plant growth regulators, which promote growth of plant organs due to conversion into Indol Acetic Acid (IAA). Auxins promote growth, increase building metabolites, retard senescence, enhance cell division, chlorophyll accumulation and stimulate dry matter production as a result of higher photosynthetic activity, consequently increase translocation and accumulation of micro elements in plant organs as well as building blocks of proteins. These results are in agreement with those reported by Sharief and El-hamady (2017) working on broad bean. They mentioned that, adding NAA levels up to 60 ppm significantly increased pods number, seeds /pod, 100-seed weight (g), seed yield/plant and seed yield (ton/ha).

The overall improvement in plant yield due to application of amino acids may be due to providing a readily source of growing substances which form the constitutes of protein in the living tissues. Also, the positive effects of amino acids application may be brought about by its cellinternal function as osmo-regulatory (Treichel, 1975) can increase the concentration of cellular osmotic components.

Table (2): Effect of folair application of GA_3 and tryptophan on yield and yield components of faba bean cv. "Giza 3" during 2023/2024 season.

Treatment	Pod weight (g)	Pod length (cm)	No. of pods/ Plant	No. of seeds/ pod	100-seed weight (g)	Seed yield (t/ ha)	Biological yield (ton/ ha)
Control	3.21	8.33	19.17	3.13	78.51	3.42	8.89
GA_3 50 mg/l	3.78	8.67	21.56	3.58	83.45	3.69	9.85
GA_3 100 mg/l	4.04	9.00	26.55	3.70	88.11	3.94	11.56
GA_3 150 mg/l	4.23	9.47	33.89	3.94	91.55	4.18	12.36
Tryptophan 100 mg/l	3.85	9.08	23.93	3.66	88.33	3.75	9.76
Tryptophan 200 mg/l	4.21	9.45	29.47	3.89	93.96	4.17	11.77
Tryptophan 300 mg/l	4.37	9.81	37.62	4.05	100.47	4.82	12.87
$LSD_{(0.05)}$	**0.26**	2.26	**3.33**	**0.35**	**1.64**	**0.52**	**3.43**

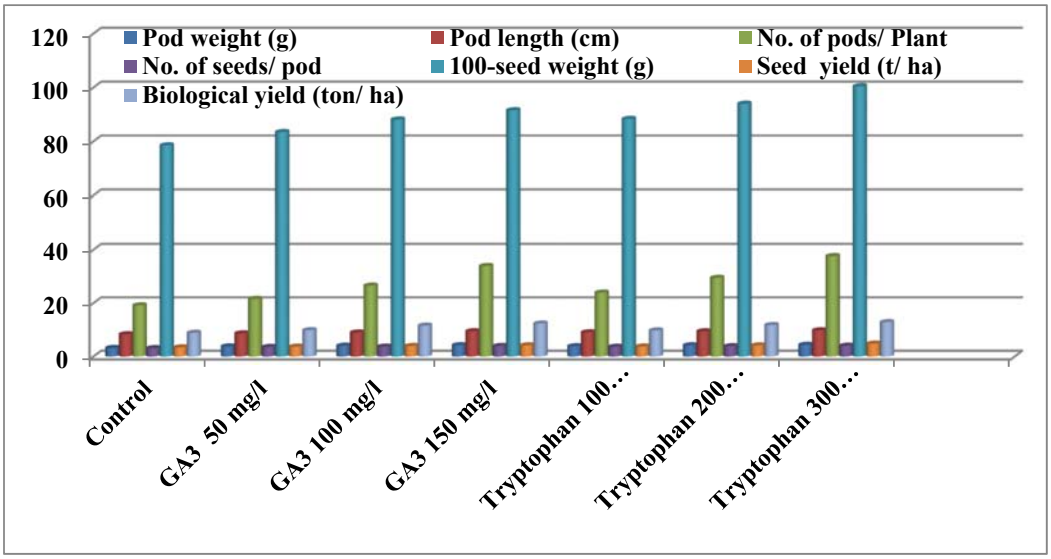

Fig. (2): Effect of folair application of GA_3 and tryptophan on yield and yield components of faba bean cv. "Giza 3" during 2022/2023 season.

C) Chemical composition:

Results in Table (3) and Figure (3) showed that all chemical composition of faba bean significant effect by folair application of GA_3 and tryptophan at diffferent concentriations. However, the results showed that folair application of tryptophan at 300 mg/l recorded the higher values of N (3.85%), P (0.76%), K (2.64%), Protein (24.06%), Total Carbohydrates (39.38 %), followed by GA_3 at (150 mg/l) N (3.77 %), P (0.61%), K (2.59%), Protein (23.58%), Total Carbohydrates (37.19 %), as compared to the control treatment which recorded lower values of N (2.77%), P (0.33%), K (1.83%), Protein (17.33%) and Total Carbohydrates (21.49 %).

Foliar treatment of amino acids promoted the synthesis of DNA and RNA and/or prevented their degradation by nuclease enzymes. It was reported that amino acids reacting directly or indirectly with reactive oxygen species, thus contributed to maintain the integrity of cell structure such as proteins, lipids and nucleic acids from damage which was induced by salt stress (Cvetkovska *et al.,* 2005). This trend might be a result of reduction in photosynthetic activity and/ or respiration in order to provide enough energy for water and nutrient absorption. The current results indicated that the application of amino acids as a foliar spray caused increases in the contents of total carbohydrates and polysaccharides of stressed and non -tressed plants. These results are in agreement with the finding of other studies on different plant species (Abdel Aziz *et al.,* 2010). There was positive correlation between photosynthesis rates and nitrogen contents in leaves. A high rate of photosynthesis due to a high nitrogen supply results in a higher biomass production (Neuberg *et al.,* 2010). Foliar nutrition in the form of hydrolyzed amino acids through foliar spray provides readymade building blocks for protein synthesis. The amino acid is absorbed by the cells as such, and is simply fed into the metabolic machinery of the cell. Evidently, the cells absorb the glutamate faster than it is metabolized, as the glutamate eventually is found in glutamine, glutathione, and protein. The subsequent utilization of these pools of free glutamate in various synthetic and derogative processes leaves little doubt that at least some plants can incorporate

amino acids directly into their metabolic pathways (El-Ghamry *et al.,* 2009).

Exogenous application of amino acids either under control water or different salinity levels caused increases in total carbohydrates % and protein % compared with the corresponding salinity levels. Abd ElMonem (2007) concluded that, there is a close relationship between the effect of amino acids and the stimulation of the photosynthetic output (soluble sugars, polysaccharides and total carbohydrates) of faba bean plant. Thus, increases the efficiency of solar energy conversion which maximizes the growth ability of faba bean and consequently increases its productivity. This is referred to the amino acids help plants grow and produce more through protein biosynthesis, phytohormones, enzyme activation, nutrient uptake, and assimilation, signalling activities, energy production, and gene transcription (Souri and Hatamian, 2019), also, Geeth and Galal (2014) pointed out that, there were significantly increase in nitrogen and protein (%) content in dry pea seeds by spraying amino acids at a rate of 100 mg/ L.

Table (3): Effect of folair application of GA_3 and tryptophan on chemical composition of faba bean cv. "Giza 3" during 2023/2024 season.

Treatment	N (%)	P (%)	K (%)	Protein (%)	Total Carbohydrates (%)
Control	2.77	0.33	1.83	17.33	21.49
GA_3 50 mg/l	3.10	0.49	2.06	19.36	27.81
GA_3 100 mg/l	3.50	0.53	2.34	21.87	33.50
GA_3 150 mg/l	3.77	0.61	2.59	23.58	37.19
Tryptophan 100 mg/l	3.06	0.58	2.24	19.13	30.87
Tryptophan 200 mg/l	3.57	0.69	2.57	22.31	35.48
Tryptophan 300 mg/l	3.85	0.76	2.64	24.06	39.38
$LSD_{(0.05)}$	**2.09**	**0.28**	**2.32**	**3.75**	**2.42**

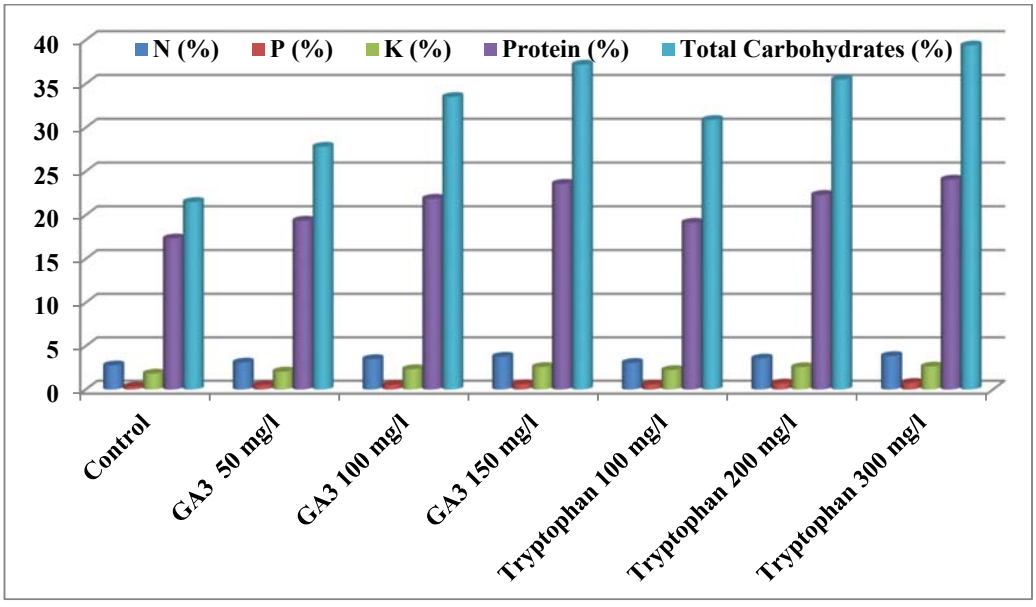

Fig. (3): Effect of folair application of GA_3 and tryptophan on chemical composition of faba bean cv. "Giza 3" during 2022/2023 season.

Conclusion:

Faba beans (*Vicia faba* L.) have mainly been used as animal feed in agriculture, but have become a greater part of the human diet in recent years as an excellent alternative to meat, because of their high protein content and relatively balanced amino acid profile. They contain bioactive compounds (proteins and their hydrolysates, phenolic compounds, soyasaponins, phytic aicds, L-DOPA, etc.) with health benefits, such as hypocholesterolemia, antioxidant, and anti-cancer properties, despite the presence of anti-nutrients that affect protein and mineral absorption. Dietary fibers and sugars in faba beans also contribute to improved blood sugar, cholesterol levels, and gut health. Use of amino acids is one of new and safety-effective technologies being applied for improving crop yield and for minimizing salinity stress-related alterations. All studied traits were significantly affected by high concentrations of gibberellic acid (150 mg/l) and tryptophan (300 mg/l). GA3 was superior in all studied traits due to the its role in increasing cells elongation and division, then increasing all vegetative growth, yield and yield components and chemical compositions

EFERENCES

Abdel Aziz, N.G.; Mazher, A.A.M. and Farahat, M.M. (2010). Response of vegetative growth and chemical constituents of Thuja orientalis L. plant to foliar application of different amino acids at Nubaria. J. Am. Sci., 6(3): 295-301.

AbdEl-Monem, AA. (2007). Polyamines as modulators of wheat growth, metabolism and reproductive development under high temperature stress. Ph.D. Thesis, Ain Shamas Univ. Cairo, Egypt.

Ahmad, A.G.; Bekheta, M.A. and Orabi, S.A. (2010). Influence of arginine on growth and productivity of two sorghum cultivars grown under water shortage. Int. J. Acad. Res., 2(1): 72-80.

Alnarp, (2013). Doctoral thesis on barley genetic resources Swedish University of Agricultural application to an organically managed crop rotation, Zemdirbyste Agric., 104(4).

Amri, B.; Khamassi, K.; Ali, M.B.; da Silva, J. A. T. and Kaab, L.B.B. (2016). Effects of gibberellic acid on the process of organic reserve mobilization in barley grains germinated in the presence of cadmium and molybdenum. South Afri. J. Bot., 106: 35-40.

Anwar, K.; Nadeem, A.; Bibi, Y.; Iftikhar, F.; Ilyas, N.; Yaseen, G. and Kabir, M. (2022). Lead harms seed germination & growth of albizia lebbeck (L.) benth. and prosopis juliflora (sw.) dc. Pak. J. Bot., 54: 121–124.

Awad, M.M.; Abd El-Hameed, A.M. and Shall, Z.S. (2007). Effect of glycine, lysine and nitrogen fertilizer rates on growth, yield and chemical composition of potato. J. Agric. Sci. Mansoura Univ., 32(10): 8541-8551.

Aydın, C.B.; Ünal, M. and Can, O. (2019). Farklı yarasa gübresi uygulamalarının marul yetiştiriciliğinde verim ve kalite üzerine etkileri. Uluslararası Tarım Yaban Hayatı Bilim Derg., 5(1): 18-24.

Basu, A.; Prasad, P.; Das, S.N.; Kalam, S.; Sayyed, R., Reddy, M. and El Enshasy, H. (2021).Plant growth promoting rhizobacteria (PGPR) as green bioinoculants: Recent developments, constraints, and prospects. Sustainability, 13: 1140.

Boras, M.; Zidan, R. and Halloum W. (2011). Effect of amino acids on growth, production and quality of tomato in plastic greenhouse. Tishreen Univ. J Res. and Sc Studies. Biolog Sci Series., 33(5): 229-238.

Bozkurt, S.B. (2019). Kapya tipi biber (*Capsicum annuum* L.) yerleştiriciliğinde kullanılan organik gübrelerin bitki gelişimi ve meyve kalitesi üzerine etkileri. Yüksek Lisans Tezi, Uludağ Üniversitesi, Fen Bilimleri Enstitüsü, Bursa, Türkiye, ss: 71.

Castro-Camba, R.; Sanchez, C.; Vidal, N. and Vielba, J. M. (2022). Plant development and crop yield: The role of gibberellins. Plants, 11(19), 2650.

Cvetkovska, M.; Rampitsch, C.; Bykova, N. and Xing, T. (2005). Genomic analysis of MAP kinase cascades in Arabidopsis defense responses. Plant Mol. Biol. Rep., 23: 331-343

Demirsoy, M. and Aydın, M. (2020). The quantitative effects of liquid vermicompost and seaweed practices on the seedling quality of organic tomato (*Solanum lycopersicum* L.). Inter J Environ Trends, 4: 17-27.

Dhull, S.B.; Kidwai, M.K.; Noor, R.; Chawla, P. and Rose, P.K. (2022). A review of nutritional profile and processing of faba bean (*Vicia faba* L.). Legume Sci., 4 (3): 129.

dos Santos, T.B.; Ribas, A.F.; de Souza, S.G.H.; Budzinski, I.G.F. and Domingues, D.S. (2022). Physiological responses to drought, salinity, and heat stress in plants: A Review. Stresses, 2: 113-135.

Du, G.; Zhang, H.; Yang, Y.; Zhao, Y.; Tang, K. and Liu, F. (2022). Effects of gibberellin pre-treatment on seed germination and seedling physiology characteristics in industrial hemp under drought stress condition. Life, 12(11): 1907.

El-Ghamry, A.M.; Abd El-Hai, K.M. and Ghoneem, K.M. (2009). Amino and Humic Acids Promote Growth, Yield and Disease Resistance of Faba Bean Cultivated in Clayey Soil. Aust. J. Basic Appli. Sci., 3(2): 731-739.

El-Zohiri, S.S.M and Asfour, Y.M. (2009). Effect of some organic compounds on growth and productivity of some potato cultivars. Ann. Agric.Sci.,Moshtohor, 47 (3): 403 -415.

Fadhil, A.H. and Almasoody, M.M.M. (2021). Effect of spraying with gibberellic acid on growth and yield of three cultivars of broad bean (*Vicia faba* L.). Indian J. Ecol., 47: 85–89.

FAO (2022). Food and agriculture organization. URL: http://www.fao.org. (accessed date: June 21, 2023).

Geeth, R.H.M. and Galal, R.M. (2014). Response of pea plant (*Pisum sativum* L.) growth and yield for spraying of amino acids and boron. Egypt. J. Appl. Sci., 29 (3):154-173.

Goss, J.A. (1973). Amino acid synthesis and metabolism. In Physiology of. Plants and their cells. Pergamon Press, Inc., New York, p.202.

Gupta, R. and Chakrabarty, S.K. (2013). Gibberellic acid in plant: still a mystery unresolved. Plant signaling & Behavior, 8(9): e25504.

Hager, A.S.; Taylor, J.P.; Waters, D.M. and Arendt, E.K. (2014). Gluten free beer-A review. Trends Food Sci. Technol., 36: 44-54.

HexaResearch (2019). Global legumes market worth USD 75.8 billion by 2025: Hexa Research. Last modified March 25, 2019.

Howitt, C.A.; Larkin, P.J. and Colgrave, M.L. (2018). Gluten reduction strategies for wheat and barley. Cereal Food World, 65: 184-187.

Karakurt, H.; Aslantaş, R. and Eşitken, A. (2010). Tohum çimlenmesi ve bitki büyümesi üzerinde etkili olan çevresel faktörler ve bazı ön uygulamalar Uludağ Üniversitesi Ziraat Fakültesi Dergisi, 24(2): 115128.

Koç, S.; Orak, A.; Tenikecier, H.S. and Sağlam, N. (2018). Relationship between Seed Yield and Yield Chracteristics in Faba Bean (*Vicia faba* L.) by GGE-Biplot Analysis. J. Life Sci., 12(2).

Kumawat, K. and Gosens, R. (2016). WNT-5A: Signaling and functions in health and disease. Cellular and Molecular Life Sci., 73:567-587.

Ma, H. Y., Zhao, D. D., Ning, Q. R., Wei, J. P., Li, Y., Wang, M. M. and Liang, Z. W. (2018). A multi-year beneficial effect of seed priming with gibberellic acid-3 (GA3) on plant growth and production in a perennial grass, Leymus chinensis. Scientific Rep., 8(1): 1-9.

Maalouf, F.; Abou-Khater, L.; Babiker, Z.; Jighly, A.; Alsamman, A.M.; Hu, J.; Ma, Y.; Rispail, N.; Balech, R. and Hamweih, A. (2022). Genetic dissection of heat stress tolerance in faba bean (*Vicia faba* L.) Using GWAS. Plants, 11, 1108

Maalouf, F.; Ahmed, S. and Bishaw, Z. (2020). Chapter 6. Faba Bean. In *Beans and Peas*; Elsevier: Amsterdam, The Netherlands,; pp. 105–131.

Mangena, P. (2020). Effect of hormonal seed priming on germination, growth, yield and biomass allocation in soybean grown under induced drought stress. Indian Journal of Agricultural Research, 54(5), 592598.

Martineau-Côté, D.; Achouri, A.; Wanasundara, J.; Karboune, S. and L'Hocine, L. (2022). Health beneficial bioactivities of faba bean gastrointestinal (in vitro) digestate in comparison to soybean and pea. Int. J. Mole. Sci., 23(16): 9210

Martineau-Côté, D.; Achouri, A.; Karboune, S. and L'hocine, L. (2022). Faba Bean: An Untapped source of quality plant proteins and bioactives. Nutri., 14: 1541.

Miceli, A.; Moncada, A.; Sabatino, L. and Vetrano, F. (2019). Effect of gibberellic acid on growth, yield, and quality of leaf lettuce and rocket grown in a floating system. Agron., 9(7): 382.

Mo, H. and Pua, E.C. (2002). Up regulation of arginine decarboxylase gene expression and accumulation of polyamines in mustard (*Brassica juncea*) in response to stress. Physiol. Planta, 114: 439 – 449.

Mohamed, O.U.Z.; Symanczik, S.E. and Larbi, S.A. (2023). Effect of PGPR and mixed cropping on mycorrhizal status, soil fertility, and date palm productivity under organic farming system. Res. Square, 1-16.

Nassar A.H.; El-Tarabily, K.A. and Sivasithamparam, K. (2003). Growth promotion of bean (*Phaseolus vulgaris* L.) by a polyamine producing isolate of streptomyces griseoluteus. Plant Growth Regul. Kluwer Academic Publishers,

Dordrecht, Netherlands, 40(2): 97-106.

Neuberg, M.; Pavlikova, D.; Pavlik, M. and Balik, J. (2010). The effect of different nitrogen nutrition on proline and asparagines content in plant. Plant Soil Environ., 56(7): 305–311.

Panahi, B. and Jalaly H.M. (2025). Navigating the barley grain quality and nutrition maze through systems seed biology. J. Agric. Food Res., 19: 101548.

Polat, H. (2020). Türkiye'de kimyasal azotlu gübre tüketim durumunun ve toprak analizi zorunluluğunun azotlu gübre kullanımına etkilerinin değerlendirilmesi. Toprak Su Derg, 9: 60-71.

Ramakrishna, W.; Rathore, P.; Kumari, R. and Yadav, R. (2020). Brown gold of marginal soil: plant growth promoting bacteria to overcome plant abiotic stress for agriculture, biofuels and carbon sequestration. Sci. Total Environ., 711: 135062.

Saleh, A.K. (1987). Plant growth organizations. Parts I and II. Directorate of books for printing and publishing - University of Mosul – Iraq

Saleh, M.M.S. (1990). Physiology of plant growth regulators. First edition. Ministry of Higher Education and Scientific Research. Salahaddin University - Iraq

Saleh, M.M. and Abdul, K.S. (1980). Effect of gibberellic acid and cycocel on growth, flowering and fruiting of tomato plant. Mesopotamia J. Agric., 15: 137-161.

Santos, T.B.; Ribas, A.F.; de Souza, S.G.H.; Budzinski, I.G.F. and Domingue, D.S. (2022). Physiological responses to drought, salinity, and heat stress in plants: a review. Stresses, 2:113–135.

Scaglia, B., Nunes, R.R., Rezende, M.O., Tambone, F. and Adani, F. (2016). Investigating organic molecules responsible of auxin-like activity of humic acid fraction extracted from vermicompost. Sci. Total Environ., 562(1): 289-295.

Sepngang, B.K.; F. Muel; T. Smadja; W. Stauss; I. Stute; M. Simmen, and M. Mergenthaler (2020). Report on legume markets in the EU. Deliverable D3.1 of the EU-project LegValue. Fachhochschule Südwestfalen Soest.

Sharief, A.E. and El-hamady, M.M. (2017). Influence of growth regulators on shedding of broad bean, growth, yield and seed quality. Int. J. Environ. Agric. Biotech., 2: 954-959.

Souri, M.K. and Hatamian, M. (2019). Amino chelates in plant nutrition: a review. J. Plant Nutr., 42(1): 67-78.

Thon, M.; Maretzki, A.; Korner, E. and Soki, W.S. (1981). Nutrient uptake and accumulation by sugar cane cell culture in relation to growth cycle. Plant Cell Tiss Org., (1): 3-14.

Thon, M.; Maretzki, A.; Korner, E. and Soki, W.S. (1981). Nutrient uptake and accumulation by sugar cane cell culture in relation to growth cycle. Plant Cell Tiss Org. (1): 3-14.

Tiwari, P.; Chintagunta, A.D.; Dirisala, V.R. and Kumar, N. S. S.(2020). Legume derived bioactive peptides. In Sustainable agriculture reviews 45: Legume agriculture and biotechnology, ed. P. Guleria, V. Kumar, and E. Lichtfouse, 1: 29–52. Cham: Springer.

Treichel, S. (1975). The effect of NaCl on the concentration of proline in different halophytes. Z. Pflanzen physiol.; 76: 56 68.

Vaughan, J.G.; Judd, P.A. and Bellamy D. (2006).The Oxford Book of Health Foods; Available:http://books.google.co .in/books pp. 37.

Velikova, V.; Yordanov, I. and Edreva, A. (2000). Oxidative stress and some antioxidant systems in acid raintreated bean plants. Protective role of exogenous polyamines. Plant Sci., 5: 59 – 66.

Villacampa, Y.; Navarro-González, F.J.; Hernández, G.; Laddaga, J. and Confalone, A. (2020). Modelling Faba Bean (*Vicia faba* L.) Biomass Production for Sustainability of Agricultural Systems of Pampas. Sust., 12*:* 9829.

Walter, G.R. and Nawacki, E. (1978). Alkaloid biolog and metabolism in plants. Planum, press, N.Y, p.152.

Yılmaz, O.; Doğuş, İ. and Yılmaz, Z.S. (2017). Kırmızı solucan gübresi kimyevi gübreye alternatif olabilir mi? 1st International Symposium on Multidisciplinary Studies and Innovative Technologies, November 2-4, Tokat, Türkiye, ss: 243.

Zulfiqar, U.; Farooq, M.; Hussain, S.; Maqsood, M.; Hussain, M.; Ishfaq, M.; Ahmad, M. and Anjum, M.Z. (2019). Lead toxicity in plants: impacts and remediation. J. Environ. Manage, 250: 109557.

إستجابة الفول البلدي صنف للرش الورقي بحمض الجبريللك والتربتوفان

إبراهيم فرج محمد أحمد
كلية الزراعة بني وليد - جامعة بني وليد-ليبيا

المستخلص

أُجريت هذه الدراسة خلال موسم 2023/2022 في مزرعة سوف الجين في بني وليد، ليبيا، خلال الموسم الزراعي الشتوي 2023/2022 لدراسة تأثيرالرش بحامض الجبريللك GA_3 بتركيزات 50، 100، 150 مجم/لتروالتريبتوفان بتركيزات 100، 200، 300 مجم /لتر ومعاملة الكنترول (ماء الصنبور) على النمو الخضري والمحصول ومكونات المحصول والتركيب الكيميائي للفول البلدي صنف "جيزة 3". نفذت التجربة وفقًا لتصميم الكتل العشوائية الكاملة (RCBD) مع ثلاث مكررات لكل معاملة. أظهرت النتائج أن زيادة تركيز التريبتوفان حتى 300 مجم/لتر أدت إلى زيادة بعض النموات الخضرية (ارتفاع النبات، عدد الفروع/النبات، طول الساق، الوزن الجاف للساق، الكلوروفيل الكلي، مساحة الورقة)، والإنتاجية ومكونات الإنتاجية (وزن القرون، طول القرون، عدد القرون/النبات، عدد البذور/القرن، وزن 100 بذور، محصول البذور، المحصول البيولوجي) والتركيب الكيميائي (النسب المئوية للنيتروجين، الفوسفور، البوتاسيوم، البروتين و الكربوهيدرات الكلية)، يليها الرش الورقي لـ GA_3 بتركيز 150 مجم/لتر ، مقارنةً بمعاملة الكنترول (الرش بماء الصنبوبر). بالإضافة إلى ذلك، كشفت النتائج أن الرش الورقي إما بالتريبتوفان أو GA_3 أدى إلى زيادات كبيرة في النمو الخضري للفول، والمحصول ومكونات المحصول، فضلاً عن تحسين كبير في الحالة الغذائية لنباتات الفول وبذوره من حيث العناصر الغذائية، والكربوهيدرات، ومحتوى البروتين. أظهرت النتائج أن الرش الورقي بالتريبتوفان كان أكثر فعالية من GA_3 فيما يتعلق بالنمو والمحصول ومكونات المحصول والمواد الكيميائية للنباتات والبذور والحالة الغذائية، خاصة عند التركيز العالي (300 مجم/لتر تريبتوفان و150 مجم/لترGA_3).

الكلمات المفتاحية: الفول البلدي (Vicia faba)، حمض الجبرليك، الأحماض الأمينية، المحصول، جودة الثمار، التركيب الكيميائي.