Journal of Crop Nutrition Science
ISSN: 2423-7353 (Print) 2538-2470 (Online)
Vol. 6, No. 4, 2020
http://JCNS.iauahvaz.ac.ir **OPEN ACCESS**

Assessment Effect of Different Amount and Time of Apply Gibberellin Acid on Quantitative and Qualitative Traits of Broad Bean

Somayeh Ghalandari[1,2], Tayeb Sakinezhad *[2]

1- *Msc. Graduated, Department of Agronomy, Khuzestan Science and Research Branch, Islamic Azad University, Ahvaz, Iran.*
2- *Department of Agronomy, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran.*

RESEARCH ARTICLE

ARTICLE INFO.
Received Date: *22 Sep. 2020*
Received in revised form: *23 Oct. 2020*
Accepted Date: *24 Nov. 2020*
Available online: *31 Dec. 2020*

To Cite This Article:
Somayeh Ghalandari, Tayeb Sakinezhad. Assessment Effect of Different Amount and Time of Apply Gibberellin Acid on Quantitative and Qualitative Traits of Broad Bean. ***J. Crop. Nutr. Sci.,*** 6(4): 1-13, 2020.

ABSTRACT

BACKGROUND: Gibberellins (GAs) are essential endogenous hormones found in plants and fungi controlling plant development by regulating several physiological mechanisms.

OBJECTIVES: This research was done to assess the effect of different amount and time of apply Gibberellin acid on quantitative and qualitative characteristics of Broad bean.

METHODS: This research was conducted according factorial experiment based on randomized complete blocks design with three replications along 2010 year. The treatments included different concentration of Gibberellin (nonuse of Gibberellin or control, 5 ppm, 50 ppm and 250 ppm) and time of application Gibberellin (Vegetative growth before flowering, flowering until pod emergence, Pod emergence until grain filing).

RESULT: Result of analysis of variance revealed effects of different amount, time of apply Gibberellin acid and interaction effect of treatments on all studied traits was significant. Assess mean comparison result of interaction effect of treatments indicated maximum amount of number of pod per plant (17.34), number of seed per pod (7.48), seed weight (1320 gr), seed yield (2899 kg.ha^{-1}), harvest index (48.50%), biologic yield (6140 kg.ha^{-1}), leaf area index (2.61), protein content (30.00%) and nitrogen content (4.80%) was noted for 50 ppm and vegetative growth before flowering and lowest amount of mentioned traits belonged to nonuse of Gibberellin acid at pod emergence until grain filing.

CONCLUSION: Use 50 ppm Gibberellin acid at vegetative growth before flowering led to produce maximum amount of quantitative and qualitative studied traits and can proposed to farmers in studied region.

KEYWORDS: *Dry weight, Leaf area index, Nitrogen, Protein, Pulse.*

***Corresponding Author:** Tayeb Sakinezhad ✉ saki1971@iauahvaz.ac.ir*

1. BACKGROUND

Broad Bean (*Vicia faba* L.) belongs to Leguminosae family. Its center of origin is west southern of Asia and as a winter crop is growing in wide level from tropical regions having moderate winter to high elevations (higher than 1200 m from sea level) (Ghasemi *et al*., 2013). There has been a renewed interest in broad bean throughout the world, which may not be unconnected with its high protein content, rising costs of protein-rich food and feed, national desires for greater self-sufficiency in food production and perhaps most importantly, the rapidly increasing human populations (Gueguen and Cerletti, 1994). *Vicia faba* L. is among the oldest crops in the world. Globally, it is third most important feed grain legume. Currently, 58 countries produce this bean on large scale. Probably faba beans are one of the best performing crops under global warming and climate change scenario because of its unique ability to excel under all most all type of climatic conditions coupled with its wide adoptability to range of soil environment. Faba bean being incredible and crop complete food, unfortunately some part of world, it is still underutilized crop and not fully exploited so far, though it is seen as an agronomically viable alternative crop to cereal, with a potential of fixing free nitrogen upto 300 kg N ha^{-1}. It is a good source of lysine rich protein and good source of L-dopa, a precursor of dopamine, can be potentially used as medicine for the treatment of Parkinson's disease. There is need to improve its anti-nutritional factors to make it more acceptable to other countries. Now Zero tannin contacting varieties are available with greater acceptability for farmers. An assessment has been made for boosting area production and acceptability with technological backup keeping in view the enormous potential for food and nutritional security (Singh *et al*., 2013). Mckenzie and Deyholos (2011) reported that treatment of GA causes stem elongation, expansion and proliferation and cell wall thickening in bast fiber of linseed. Phytohormones have significant roles in plant growth and development and respond to biotic and abiotic stresses. The plant needs growth regulators in order to complete the growth, because of its important role in improving biological activity, as many researches and studies indicated that the treatment of plants with a specific growth regulator leads to the improvement of the plant structure and the yield quality and the production of seeds (Khalaf and Rajbo 2006). Gibberellins (GAs) are growth hormones strongly involved in a wide variety of physiological activities. Currently, gibberellins are commercially used to enhance phenotypic characteristics, earliness, and productivity of many vegetable and ornamental crops (Miceli *et al*., 2019). Ibrahim *et al*. (2007) by studied influence of some bioregulators (Gibberellic acid or GA, Indole acetic acid or IAA, benzyl adenine at the rate of 100 ppm or growth retardant ancymidol at the rate of 100 ppm) on agronomic traits of *Vicia faba* reported application of all the used treatments led to significant changes in the following items: plant height, average number of leaves,

leaf area per plant and the dry weight of the shoot in both seasons. Application of benzyl adenine, IAA or ancymidol caused reduction in the flower abscission percentage and then producing the highest number of pod setting during the two seasons. All the used treatments of bioregulators caused marked changes in the seed yield and its components per plant (pod length, number of pods/plant, number and weight of seeds per pod as well as weight of 100 seeds). Photosynthetic pigments and mineral ions (Ca, K, and Mg) contents were gradually increased with plant age up to 90 days after sowing due to application of the bioregulators. All the used bioregulators caused significant increase in the protein and total carbohydrate percentage of the produced seeds resulted from the treated plants. The highest values of protein (25.46%) and carbohydrate (59.94%) were obtained from usen of benzyl adenine at the first season.

2. OBJECTIVES

This research was done to assess effect of different amount and time of apply Gibberellin on quantitative and qualitative traits of Broad bean.

3. MATERIALS AND METHODS

3.1. Field and Treatments Information

This research was carried out via factorial experiment based on randomized complete blocks design with three replications along 2010 year. Place of research was located in Ahvaz city at longitude 48°40'E and latitude 31°20'N in Khuzestan province (Southwest of Iran). The treatments included different concentration of Gibberellin (nonuse of Gibberellin or control, 5 ppm, 50 ppm and 250 ppm) and time of application Gibberellin (Vegetative growth before flowering, flowering until pod emergence, Pod emergence until grain filing). This experiment had 36 plots. Each plot consisted of 7 lines with a distance of 60 cm and 5 meters length. The distance between the shrubs on every row was 15 cm.

3.2. Farm Management

Base fertilizers (75 kg.ha^{-1} Nitrogen from urea, 100 kg.ha^{-1} phosphorus from ammonium phosphate and 80 kg.ha^{-1} potassium from potassium sulfate) were added to the soil based on soil tests and the recommendations of the Iranian Soil and Water Research Institute at the planting stage. Also 50 kg.ha^{-1} nitrogen added at stem elongation stage. Physical and chemical properties of studied soil were mentioned in table 1. To combat the weeds during the growth, weeding and thinning was done manually.

Table 1. Physical and chemical properties of studied field

Soil depth (cm)	**SP (%)**	**EC (ds.m^{-1})**	**pH**
0-30	50	11.48	7.95
30-60	51	12.1	7.9
Soil depth (cm)	**N (%)**	**P (ppm)**	**K (ppm)**
0-30	0.07	4.6	202
30-60	0.052	4.0	171
Soil depth (cm)	**TNV (%)**	**OM (%)**	**OC (%)**
0-30	36	1.24	0.72
30-60	39	0.95	0.55

3.3. Measured Traits

Characteristics such as plant height, node number, node length, stem number and pod length was measured. In final harvest area, one- square meter of each plot, seed yield were calculated. In addition, seed samples were dried and weighed. In order to determine the leaf and stem dry weight two planting lines from each plot harvested and after the removal of marginal effect were carried to the laboratory and were placed in the oven at 75°C for 48 hours and after ensuring that the samples were completely dry, they were weighed and finally the dry matter was measured. Kjeldahl method was used to determine the amount of plant nitrogen content. Finally, nitrogen percentage was calculated as follow (Sosulski and Imafidon, 1990):

Equ. 1. Protein content= Nitrogen percentage × 5.7.

Harvest index (HI) was calculated according to formula of Gardener *et al*. (1985) as follows:

Equ.2. HI= (Seed yield/Biologic yield) ×100.

To determine the leaf area of the linear relationship S= K. L.W was used in which S, L and W were the leaf area, L and W respectively, the maximum length and width of each leaf and K= 0.75 correction coefficient. The leaf area index was calculated from leaf area ratio to ground level.

3.4. Statistical Analysis

All data analyzed via MSTAT-C software and the means were compared by using LSD test at 5% probability level.

4. RESULT AND DISCUSSION

4.1. Number of pod per plant

This trait can be considered as one of the most important components of yield, because pods contain seeds and participate in growth and development in the early stages of grain filling through photosynthesis. According result of ANOVA effect of different amount, time of applies Gibberellin acid and interaction effect of treatments on trait was significant at 1% probability level (Table 2). Result of mean comparison showed maximum of number of pod per plant (15.40) was obtained for 50 ppm Gibberellin acid and minimum of that (11.85) was for control treatment (Table 3). Investigation mean comparison result indicated in different level of time of applies Gibberellin acid maximum number of pod per plant (14.90) was noted for vegetative growth before flowering and minimum of that (12.99) belonged to pod emergence until grain filing (Table 4). Assess mean comparison result of interaction effect of treatments indicated maximum number of pod per plant (14.34) was noted for 50 ppm and vegetative growth before flowering and lowest one (11.33) belonged to nonuse of Gibberellin acid at pod emergence until grain filing (Table 5). So gibberellic acid can also have a positive effect on number of pods per plant due to its positive effect on fertile branches. Eid *et al*. (1992), stated number of pods is related to number of flowers produced per plant and flower stability, gibberellin is also effective in maintaining flowers and their number during growing season and has a positive effect on number of pods.

Table 2. Result analysis of variance of measured traits

S.O.V	df	No. pod per plant	No. seed per pod	Seed weight	Seed yield	Harvest index
Replication	2	0.02^{ns}	0.11^{ns}	1.82^{ns}	27630.32^{ns}	0.0001^{ns}
Gibberline concentration (GC)	3	26.33**	571.39**	654.6**	844221.83*	6.25**
Growth stage (GS)	2	2.43**	84.65**	327.87**	87210.47*	1.75**
GC × GS	6	0.94**	70.56**	3767.98**	68911.76*	0.75**
Error	22	0.03	0.13	3.09	27837.53	0.0001
CV (%)	-	10.24	9.65	7.6	11.17	7.1

$^{ns, *\text{ and }**}$: no significant, significant at 5% and 1% of probability level, respectively.

Continue table 2.

S.O.V	df	Biologic yield	Leaf area index	Protein content	Nitrogen content
Replication	2	13648.12^{ns}	0.04^{ns}	0.004^{ns}	0.01^{ns}
Gibberline concentration (GC)	3	307043.22*	1.66*	23.77*	0.48*
Time of application Gibberline (GS)	2	283584.03*	1.006*	1.02*	0.39*
GC × GS	6	242347.53*	1.25*	1.03*	0.62*
Error	22	13746.55	0.008	0.005	0.01
CV (%)	-	11.33	10.24	9.67	8.1

$^{ns, *\text{ and }**}$: no significant, significant at 5% and 1% of probability level, respectively.

4.2. Number of seed per pod

The importance of this attribute is because the higher the number of grains means the larger the sink and the more it receives photosynthetic material, the larger and more powerful the sink, led the higher yield. Result of analysis of variance revealed effects of different amount, time of apply Gibberellin acid and interaction effect of treatments on number of seed per pod was significant at 1% probability level (Table 2). Assess mean comparison result indicated in different level of Gibberellin acid concentration the maximum number of seed per pod (7.00) was noted for 50 ppm Gibberellin acid and minimum of that (4.48) belonged to control treatment (Table 3). These results indicate that the effective hormone concentration was 50 ppm and the growth period before flowering was better time for hormone consumption. Again, it can be said that in these conditions, the plant is still young and effective. Compare different level of time of applies Gibberellin acid showed that the maximum and the minimum amount of number of seed per pod belonged to vegetative growth before flowering (6.19) and pod emergence until grain filing (5.54) treatments (Table 4). Evaluation mean comparison result of interaction effect of treatments indicated maximum number of seed per pod (7.48) was noted for 50 ppm and vegetative growth before flowering and lowest one (4.40) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5).

Table 3. Mean comparison effect of Gibberline concentration on measured trait

Gibberline concentration	No. pod per plant	No. seed per pod	Seed weight (gr)	Seed yield ($kg.ha^{-1}$)	Harvest index (%)
5 ppm	13.86b	5.64ab	1312b	2504b	46.47ab
50 ppm	15.40a	7.00a	1318a	2761a	48.03a
250 ppm	14.24ab	6.07ab	1314ab	2365c	47.23ab
Control	11.85c	4.48b	1300c	1983d	45.45b
LSD	1.17	0.23	3.01	55.1	1.01

*Similar letters in each column show non-significant difference at 5% probability level.

Continue table 3.

Gibberline concentration	Biologic yield ($kg.ha^{-1}$)	Leaf area index	Protein content (%)	Nitrogen content (%)
5 ppm	5106b	1.61ab	27.50ab	3.93ab
50 ppm	5881a	2.43a	29.67a	4.64a
250 ppm	5413ab	1.91ab	28.34ab	4.23ab
Control	4290c	1.42b	26.51b	3.70b
LSD	262.5	0.09	0.18	0.20

*Similar letters in each column show non-significant difference at 5% probability level.

Mentioned result was consistent with the findings of Ngatia *et al*. (2004), who believe that gibberellin spray in the vegetative phase is effective on the number of seeds per pod.

4.3. Seed weight

Seeds inside a pod do not have the same physiological value. This non-uniformity occurs due to unfavorable environmental conditions during seed embryo development, and as a result, in the pod, only one of the fertile eggs becomes a mature seed. In the next stage or at the end of the pod elongation stage, if the conditions are unfavorable, two or three seeds will appear. At the beginning of the rapid grain filling period, the unequal physiological value of the seeds leads to different seed sink capacity of a pod, thus leading to the formation of seeds of different sizes (Patarx, 2019). According result of analysis of variance effect of different amount, time of applies Gibberellin acid and interaction effect of treatments on seed weight was significant at 1% probability level (Table 2). Mean comparison result of different level of Gibberellin acid concentration indicated that maximum seed weight (1318 gr) was noted for 50 ppm Gibberellin acid and minimum of that (1040 gr) belonged to control treatment (Table 3). As for Duncan classification made with respect to different level of time of applies Gibberellin acid maximum and minimum amount of seed weight belonged to Vegetative growth before flowering (1313 gr) and pod emergence until grain filing (1309 gr) (Table 4). Evaluation mean comparison result of interaction

effect of treatments indicated maximum seed weight (1320 gr) was noted for 50 ppm and vegetative growth before flowering and lowest one (1299 gr) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5). It seems the 1000-seed or 100-seed weight is one of the most stable traits of the bean plant. Although the seeds that form at the end nodes of the plant or the end of the pod may weigh less, the weight of 100-seed or 1000-seed is significantly more stable.

Table 4. Mean comparison effect of different time of application Gibberline on measured trait

Time of application Gibberline	No. pod per plant	No. seed per pod	Seed weight (gr)	Seed yield (kg.ha^{-1})	Harvest index (%)
Vegetative growth before flowering	14.90a	6.19a	1313a	2478a	47.20a
Flowering until pod emergence	13.98ab	5.66b	1311ab	2399ab	46.71b
Pod emergence until grain filing	12.99b	5.54b	1309b	2330b	46.44b
LSD	0.85	0.13	1.02	59.3	0.28

*Similar letters in each column show non-significant difference at 5% probability level.

Continue table 4.

Time of application Gibberline	Biologic yield (kg.ha^{-1})	Leaf area index	Protein content (%)	Nitrogen content (%)
Vegetative growth before flowering	5366a	2.01a	28.98a	4.26a
Flowering until pod emergence	5188ab	1.81ab	28.00b	4.11ab
Pod emergence until grain filing	4964b	1.74b	27.59c	3.99b
LSD	113.9	0.05	0.50	0.09

*Similar letters in each column show non-significant difference at 5% probability level.

4.4. Seed yield

The increase in the number of pods per plant and the mass of 100 seeds can be related to the better production of the parameters responsible for the overall increase in seed yield. High levels of gibberellic acid have improved the grain yields of many legumes, including beans. The increase in grain yield in some cereals is mainly due to the increase in harvest coefficient, in other words, the plant does not produce excess dry matter, but allocates a large part of the dry matter to the economic yield of seed (Zianto, 2016). Result of analysis of variance revealed effects of different amount, time of apply Gibberellin acid and interaction effect of treatments on seed yield was significant at 5% probability level (Table 2). Mean comparison result of different level of Gibberellin acid concentration indicated that maximum seed yield (2761 kg.ha^{-1}) was noted for 50 ppm Gibberellin acid and minimum of that (1983 kg.ha^{-1}) belonged to control treatment (Table 3). As for Duncan classification made with respect to different level of time of ap-

plies Gibberellin acid maximum and minimum amount of seed yield belonged to Vegetative growth before flowering (2478 kg.ha^{-1}) and pod emergence until grain filing (2330 kg.ha^{-1}) (Table 4). Assessment mean comparison result of interaction effect of treatments indicated maximum seed yield (2899 kg.ha^{-1}) was noted for 50 ppm and vegetative growth before flowering and lowest one (1898 kg.ha^{-1}) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5). The mentioned result was similar to findings of Negatia *et al*. (2004), they are reported increase in seed yield is probably due to improved flowering, pod number and seed mass. Also, the increase in grain yield can be related to the effect of gibberellic acid hormone on pod weight, 100 grain weight and increased carbon stabilization due to the increase in leaf area index.

4.5. Harvest index

Two useful terms used to describe the allocation of dry matter in plants are biological yield and economic yield. The term biological yield is used to denote the accumulation of dry matter in a plant system, and economic yield or agricultural yield is used to describe the volume or weight of the organs that make up the crop and have economic or agricultural value. That ratio of biological yield that constitutes economic yield is called the coefficient of harvest or the yield of efficiency or the coefficient of displacement (Tianam, 2019). According result of analysis of variance effect of different amount, time of applies Gibberellin acid and interaction effect of treatments on harvest index was significant at 1% probability level (Table 2). According result of mean comparison maximum of harvest index (48.03%) was obtained for 50 ppm Gibberellin acid and minimum of that (45.45%) was for control treatment (Table 3). Evaluation mean comparison result indicated in different level of time of applies Gibberellin acid the maximum harvest index (47.20%) was noted for vegetative growth before flowering and minimum of that (46.44%) belonged to pod emergence until grain filing (Table 4). Evaluation mean comparison result of interaction effect of treatments indicated maximum harvest index (48.50%) was noted for 50 ppm and vegetative growth before flowering and lowest one (45.15%) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5). The maximum dry matter yield of whole beans is achieved at the physiological maturity stage. After this stage, the total dry matter yield is reduced by 10 to 20%, and this is due to the shading of the leaves and the re-transfer of nutrients to the roots and the secretion of various substances from the roots to the soil (Rikat, 2018). Increased seed yield of legumes can be related to the effect of gibberellic acid on pods and mass of 100 grains, increased carbon stabilization due to gibberellic acid which leads to an increase in leaf area index which leads to an increase in plant dry matter, Increased growth and development leads to an increase in total dry mass and germination and, consequently, an increase in flowering, pod production and seed mass, which ulti-

mately leads to an increase in the harvest index (Negatia *et al*., 2004).

4.6. Biologic yield

Result of analysis of variance revealed effects of different amount, time of apply Gibberellin acid and interaction effect of treatments on biologic yield was significant at 5% probability level (Table 2). Assessment mean comparison result indicated in different level of Gibberellin acid concentration the maximum biologic yield (5881 kg.ha^{-1}) was noted for 50 ppm Gibberellin acid and minimum of that (4290 kg.ha^{-1}) belonged to control treatment (Table 3). Compare different level of time of applies Gibberellin acid showed that the maximum and the minimum amount of biologic yield belonged to vegetative growth before flowering (5366 kg.ha^{-1}) and pod emergence until grain filing (4964 kg.ha^{-1}) treatments (Table 4). Evaluation mean comparison result of interaction effect of treatments indicated maximum biologic yield (6140 kg.ha^{-1}) was noted for 50 ppm and vegetative growth before flowering and lowest one (4021 kg.ha^{-1}) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5).

4.7. Leaf area index

The expansion of bean vegetation is very slow at the beginning of growth so that it will not be able to compete with the growth of adjacent weeds and in this case will need weeding. If the plant has a favorable leaf area index during the reproductive period when the plant is at its maximum activity for making photosynthetic materials and transferring materials, the yield of bean seeds will also increase (Lack and Alavifazel, 2001). According result of analysis of variance effect of different amount, time of applies Gibberellin acid and interaction effect of treatments on leaf area index was significant at 5% probability level (Table 2). Mean comparison result of different level of Gibberellin acid concentration indicated that maximum leaf area index (2.43) was noted for 50 ppm Gibberellin acid and minimum of that (1.42) belonged to control treatment (Table 3). As for Duncan classification made with respect to different level of time of applies Gibberellin acid maximum and minimum amount of leaf area index belonged to Vegetative growth before flowering (2.01) and pod emergence until grain filing (1.74) (Table 4). Assess mean comparison result of interaction effect of treatments revealed maximum leaf area index (2.61) was noted for 50 ppm and vegetative growth before flowering and lowest one (1.43) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5). By providing a larger leaf area exposed to sunlight, it stabilizes the absorption of more carbon dioxide. Conversely, plants with lower leaf area index stabilize less carbon dioxide, and by increasing leaf area, the ability to stabilize carbon dioxide in the plant can be increased. Therefore, this positive result can be achieved by consuming hormones in the period of vegetative growth before flowering. It can be concluded that if the hormone is used in the vegetative growth period before flowering, it will have a better result in terms of effectiveness. Because the plant is

still young and can be more affected by the environment and environmental factors, increasing the higher leaf area will lead to more dry matter production. However, it should be noted that with increasing concentration of gibberellic acid, leaf area does not rise as much because it can be said that high concentration of gibberellic acid has a growth inhibitory state. The mentioned result was similar to finding of Leite *et al*. (2003) and Mburu (1996).

Table 5. Mean comparison interaction effect of treatment on measured traits

Gibberline concentration	Time of application Gibberline	No. pod per plant	No. seed per pod	Seed weight (gr)	Seed yield (kg.ha^{-1})	Harvest index (%)
5 ppm	Vegetative growth before flowering	15.55b	5.80c	1313b	2532c	46.80ab
	Flowering until pod emergence	13.81d	5.63c	1312c	2510c	46.45b
	Pod emergence until grain filing	12.23de	5.50c	1311c	2471bc	46.10b
50 ppm	Vegetative growth before flowering	17.34a	7.48a	1320a	2899a	48.50a
	Flowering until pod emergence	15.35b	6.80b	1318ab	2736ab	47.88ab
	Pod emergence until grain filing	13.53e	6.72c	1315b	2650b	47.71ab
250 ppm	Vegetative growth before flowering	14.55b	6.89b	1316ab	2451d	47.69ab
	Flowering until pod emergence	14.97c	5.79c	1314b	2345e	47.11ab
	Pod emergence until grain filing	13.2d	5.55c	1312c	2300e	46.90b
Control	Vegetative growth before flowering	12.17de	4.59de	1302d	2030f	45.82bc
	Flowering until pod emergence	12.1de	4.45de	1300de	2021g	45.41bc
	Pod emergence until grain filing	11.33e	4.40e	1299e	1898h	45.15c
LSD		0.09	0.02	0.88	10.5	0.41

*Similar letters in each column show non-significant difference at 5% probability level.

4.8. Protein content

Result of analysis of variance revealed effects of different amount, time of apply Gibberellin acid and interaction effect of treatments on protein content was significant at 5% probability level (Table 2). Mean comparison result of different level of Gibberellin acid concentration indicated that maximum protein content (29.67%) was noted for 50 ppm Gibberellin acid and minimum of that (26.51%) belonged to control treatment (Table 3). As for Duncan classification made with respect to different level of time of applies Gibberellin acid maximum and minimum amount of protein content belonged to Vegetative growth before flowering (28.98%) and pod emergence until grain filing (27.59%) (Table 4). Perhaps because the hormone is involved in the synthesis and absorption of assimilates, the amount of nitrogen and subsequent protein concentration is increased.

Shafaat and Shabana (1980) reported that gibberellins play an important role in cell enlargement and protein synthesis, and that this hormone is produced in the seed within the fruit and its foliar application increases the quantity and quality of various fruits. According to Hobollah *et al*. (1984), hormonal compounds and growth regulators increase the production of proteins by increasing RNA production and RNA polymerase activity. Assess mean comparison result of interaction effect of treatments indicated maximum protein content (30.00%) was noted for 50 ppm and vegetative growth before flowering and lowest one (26.11%) belonged to non-use of Gibberellin acid and pod emergence until grain filing (Table 5).

Continue table 5.

Gibberline concentration	Time of application Gibberline	Biologic yield (kg.ha^{-1})	Leaf area index	Protein content (%)	Nitrogen content (%)
5 ppm	**Vegetative growth before flowering**	5236ab	1.74e	27.97f	4.05de
	flowering until pod emergence	5184bc	1.60f	27.43g	3.90e
	Pod emergence until grain filing	4900b	1.50g	27.10h	3.85ef
50 ppm	**Vegetative growth before flowering**	6140a	2.61a	30.00a	4.80a
	flowering until pod emergence	5878bc	2.39ab	29.85ab	4.65ab
	Pod emergence until grain filing	5625b	2.29ab	29.17b	4.49b
250 ppm	**Vegetative growth before flowering**	5528b	2.10c	28.83c	4.40bc
	Flowering until pod emergence	5400bc	1.90d	28.20d	4.20c
	Pod emergence until grain filing	5311bc	1.75e	28.01de	4.10cd
Control	**Vegetative growth before flowering**	4560d	1.47g	26.90i	3.80g
	Flowering until pod emergence	4291e	1.36gh	26.53j	3.70h
	Pod emergence until grain filing	4021f	1.43h	26.11k	3.60i
LSD		100.8	0.10	0.20	0.04

*Similar letters in each column show non-significant difference at 5% probability level.

4.9. Nitrogen content

According result of analysis of variance effect of different amount, time of applies Gibberellin acid and interaction effect of treatments on nitrogen content was significant at 5% probability level (Table 2). Mean comparison result showed in different level of Gibberellin acid concentration the maximum nitrogen content (4.64%) was noted for 50 ppm Gibberellin acid and minimum of that (3.70%) belonged to control treatment (Table 3). Compare different level of time of applies Gibberellin acid

showed that the maximum and the minimum amount of nitrogen content belonged to vegetative growth before flowering (4.26%) and pod emergence until grain filing (3.99%) treatments (Table 4). Evaluation mean comparison result of interaction effect of treatments indicated maximum nitrogen content (4.80%) was noted for 50 ppm and vegetative growth before flowering and lowest one (3.60%) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5). The synthetic structure of the protein is amino acid and the element nitrogen is the main component of the protein. The higher biological fixation nitrogen, led to improve nitrogen, followed by a higher protein concentration (Tikanlp, 2018).

5. CONCLUSION

Use 50 ppm Gibberellin acid at vegetative growth before flowering led to produce maximum amount of quantitative and qualitative studied traits.

ACKNOWLEDGMENT

Authors thank all colleagues and participants, who took part in the study.

FOOTNOTES

AUTHORS' CONTRIBUTION: All authors are equally involved.

CONFLICT OF INTEREST: Authors declared no conflict of interest.

FUNDING/SUPPORT: This study was done by support of Department of Agronomy, Islamic Azad University, Khuzestan Science and Research Branch.

REFRENCES

Eid, S. M. M., H. H. Abbas. and F. A. Abo-Sedera. 1992. Effects of GA3 foliar spray on plant growth, chemical composition, flowering, pod yield and chemical composition of green seeds of pea plant grown under salinity stress. Annals Agri. Sci. Moshtohor. 30: 1443-145.

Gardner, F. P., R. B. Pearce. and R. L. Mitchell. 1985. Physiology of crop plants. Ames, IA: Iowa State Univ. Press. USA. 121 pp.

Ghasemi, A., A. K Ejraei. and M. Rajaei. 2013. Effect of Silicon on vegetative and generative performance of Broad Bean (*Vicia faba* L.). J. Nov. Appl. Sci. 2(S): 881-884.

Gueguen, J. and P. Cerletti. 1994. Proteins of some legume seeds: soybean, pea, fababean and lupin. *In*: New and Developing Sources of Food Proteins. Springer, US, pp. 145–193.

Hassaballa, I. A., E. Y. Youssef, M. A. Ibrahom. and S. E. Khalifaa. 1984. Effect of som growth regulators on Yield and physical characteristics of Zaghloud data fruits. Annual Agri. Sci. moshtohor. 20: 316-332.

Ibrahim, M. E, M. ABekheta, A. El-Moursi. and N. A. Gaafar. 2007. Improvement of growth and seed yield quality of *Vicia faba* L. plants as affected by application of some bioregulators. Aust. J. Basic and Appl. Sci. 1(4): 657-666.

Khalaf, A. S. and A. S. A. Al-Rajbo. 2006. Seed technology. Dar Ibn Al Atheer Printing and Publishing. University of Mosul. Iraq.

Lack, Sh. and M. Alavifazel. 2001. Investigation of the effect of nitrogen and plant density on the growth curve and quantitative and qualitative yield of Faba bean in Ahvaz climate. Res. Rep. Islamic Azad University. Ahvaz Branch. 69 pp. (Abstract in English)

Leite, V. M., C. A. Rosolem. and J. D. Rodrigues. 2003. Gibberelline and cytokenin effects on soybean growth. Scientia Agricola. 60: 537-541.

Mburu, M. W. 1996. THE effects of irrigation, fertilizer nitrogen and planting density on bean (*Phaseolus vulgaris* L.) yield under different weather conditions. Ph.D. Thesis. Dep. Soil Sci. Reading. Univ. UK.

Mckenzie, R. R. and M. K. Deyholos. 2011. Effect of plant growth regulators treatments on stem vascular tissue development in linseed (*Linum usitatissimum* L.). Industrial Crops Prod. 34: 1119-1127.

Miceli, A., A. Moncada, L. Sabatino. and F. Vetrano. 2019. Effect of Gibberellic acid on growth, yield, and quality of leaf Lettuce and rocket grown in a floating system. Agronomy. 9(382): 1-22.

Ngatia, T. M., V. E. Emongor. and S. D. Obukosia. 2004. Effect of levels and timing of application of gibberellic acid on growth and yield components of common beans. Afri. Crop Sci. J. 12: 123-131.

Patarx, Z. 2019. Evaluation effect of Growth hormone (Gibberellin Acid) on Seed yiels and its components of *Vicia faba* under salinity stress condition. Msc. Thesis. Otarpabon Univ. 123 pp.

Tianam, X. 2019. Investigation effect of different level of gibberellin hormone on growth indices and crop production of broad bean. Res. Rep. Carlan Agri. Res. Org. 61 pp.

Rikat, K. 2018. Response of physiological traits of *Vicia faba* to several concentration of gibberellin hormone. Res. Rep. Gatan Agri. Res. Org. 62 pp.

Shafaat, M. and H. R. Shabana. 1980. Effects of naphthalene acetic acid on fruit size, quality and ripening of Zahedi data palm. Hort Sci. 15: 727-752.

Singh, A. K., R. C. Bharati, N. Ch. Manibhushan. and A. Pedpati. 2013. An assessment of faba bean (*Vicia faba* L.) current status and future prospect. Afri. J. Agri. Res. 8(50): 6634-6641.

Sosulski, F. W. and G. I. Imafidon. 1990. Amino acid composition and nitrogen-to-protein conversion factors for animal and plant foods. J. Agric. Food. Chem. 38: 1351-1356.

Tikanlp, Z. 2018. Evaluation biological fixation nitrogen in pulse crop. Res. Rep. Agri. Res. Org. Pantalok Univ. 45 pp.

Zianto, S. 2016. Assess crop production of broad bean affected different level of gibberellic acid. Msc. Thesis. Patral Univ. 105 pp.