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Response of Morphological Traits of Broad Bean (*Vicia faba* L.) to Use Different Amount and Time of Apply Gibberellin Acid

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ABSTRACT

BACKGROUND: 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.

OBJECTIVES: The current study was conducted to evaluate the effect different amount and time of apply Gibberellin acid on morphological characteristics and crop production of Broad bean.

METHODS: This research was carried out via 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: According result of analysis of variance effect of different amount, time of applies Gibberellin acid and interaction effects of treatments on all studied traits were significant. Evaluation mean comparison result of interaction effect of treatments on all measured traits revealed the highest amount of plant height (91.46 cm), node number (29.35), node length (4.98 cm), stem number (13.30), pod length (17.79 cm), seed yield (2899 $kg.ha^{-1}$), Stem dry weight (1693 $kg.ha^{-1}$) and Leaf dry weight (958 $kg.ha^{-1}$) were noted for 50 ppm and vegetative growth before flowering and lowest amount of mentioned traits belonged to nonuse of Gibberellin acid and apply Gibberellin at pod emergence until grain filing.

CONCLUSION: Finally according result of current study apply 50 ppm Gibberellin acid at vegetative growth before flowering had the highest amount of studied traits and it can be advice to producers in studied region.

KEYWORDS: *Growth regulator, Hormone, Node, Pod, Pulse.*

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1. BACKGROUND

Vicia faba L. is one of the oldest crops grown by man, as it has been cultivated for c. 8000–10000 years and is native to the Near East and Mediterranean Basin area (Zohary, D. and M. Hopf, 2000). Broad bean is one of the main vegetable legume plants which have high protein content. This made it one of the sources of green protein, They are an important part of human food, especially low-income people, it is also important in improving soil fertility through the biological of nitrogen fixation in the soil by commensalism with bacteria of Rhizobium (Kandil and Hala, 2007). It is used as a human food because of its high protein, high starch content, and low lipid content; as feed for many animals; and for green manure (Crépon *et al*., 2010). Broad bean is one of the best crop that can be used as green manure and one of the best bio factory of nitrogen by fixing 130 to 160 kg N/ha (Singh *et al*., 2013a). Faba bean cannot only be grown on diver's agro-climatic conditions successfully, but it can also be produced on residual soil moisture, relatively more tolerant to biotic and abiotic stress, with minimum input (Singh *et al*., 2013b). Plant regulators are organic compounds which, in small amounts, somehow modify a given physiological plant process and rarely act alone, as the action of two or more of these compounds is necessary to produce a physiological effect. Gibberellins (GAs) play an essential role in many aspects of plant growth and development, such as seed germination (Leite *et al*., 2003). GAs can stimulate stem and root elongation, leaf expansion, flowering, fruit senescence, seed germination, or dormancy (Hedden and Sponsel, 2015). They induce transcription of genes involved in cell elongation and cell division occurring during growth (Sun, 2004); moreover, they can also stimulate the expression of hydrolytic enzymes involved in the conversion of starch to sugar (Basra, 2000). By controlling starch accumulation and use, gibberellin can influence overall plant growth. Thus, the GA signal in plant tissue can be converted into alterations in gene expression, plant physiology and morphology (Sun, 2004). When the gibberellin-based products became commercially available, the astonishing results obtained from their application to many crops raised great expectations of consistently increasing plant productivity (Rodrigues and Leite, 2004). Exogenous applications of gibberellins were shown to actively influence various physiological activities, such as vegetative growth, flowering and flower morphology, earliness, fruit set, ion transport and osmoregulation, leaf area expansion, internode elongation and can also increase biomass production, fruit weight and dry matter (Azuma *et al*., 1997; Yang *et al*., 1992). These effects can vary greatly depending on hormone requirement, relative concentrations, and plant responses at different growth stages (Robert, 1999). Many studies have focused the attention on the use of this phytohormone for improving the productivity and quality of several crop plants (Shah *et al*., 2006; Singh, 1995). GAs have been commercially applied to control the vegetative growth of many

horticultural crops. They might increase seed yield in firm-headed lettuce, enhance growth and sugar accumulation in sugar cane, accelerate peduncle elongation and bud development in artichokes and strawberry, etc. Recently, the application of exogenous gibberellic acid (GA3) has gained a renewed interest with the aim to promote plant growth, improve yield and increase tolerance to abiotic stresses (Maggio *et al*., 2010). Application of gibberellic acid, 4-chloroindole and 6-benzyl amino-purine on to the standard petal and calyx of *Vicia faba* var. major before or after tripping was found to significantly enhance pod set (Rylott and Smith, 1990). Likewise, spraying of *Vicia faba* cv. Troy reproductive structure with indole-3-acetic acid, gibberellic acid or 6-benzylaminopurine resulted in increased pod number (Clifford *et al*., 1992).

2. OBJECTIVES

The current study was conducted to evaluate the effect different amount and time of apply Gibberellin acid on morphological characteristics and crop production 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.

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.

Table 1. Physical and chemical properties of studied field

Soil depth (cm)	SP (%)	EC ($ds.m^{-1}$)	pH	TNV (%)	OM (%)	OC (%)
0-30	50	11.48	7.95	36	1.24	0.72
30-60	51	12.1	7.9	39	0.95	0.55
Soil depth (cm)	**N (%)**	**P (ppm)**	**K (ppm)**	**Sand (%)**	**Silt (%)**	**Clay (%)**
0-30	0.07	4.6	202	14	53	33
30-60	0.052	4.0	171	12	57	31

3.4. Statistical Analysis

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

4. RESULT AND DISCUSSION

4.1. Plant height

According result of analysis of variance effect of different amount, time of applies Gibberellin acid and interaction effect of treatments on plant height was significant at 1% probability level (Table 2). Mean comparison result of different level of Gibberellin acid concentration indicated that maximum plant height (88.55 cm) was noted for 50 ppm Gibberellin acid and minimum of that (71.64 cm) 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 plant height belonged to Vegetative growth before flowering (82.29 cm) and pod emergence until grain filing (76.80 cm) (Table 4). Evaluation mean comparison result of interaction effect of treatments indicated maximum plant height (91.46 cm) was noted for 50 ppm and vegetative growth before flowering and lowest one (70.46 cm) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5). Marschner (1986) indicated that application of GA and/or IAA on higher plants caused elongation in the primary cells in the young tissues and growth centers. In this respect, other investigators reported that faba bean plant height 3 was increased due to foliar application of GA or IAA as recorded by Shalaby and Ahmed (1994) and Abdel-Fattah (1997). In addition, Bekheta (2004) reported that foliar application of GA on wheat plants caused increase in plant height. In the present work the reduction in plant height due to application of growth retardant ancymidol might be attributed to interference of ancymidol in the gibberellin biosynthesis through preventing oxidation of ent-kaurene to ent-kaurenoic acid which led to inhibition of gibberellin biosynthesis (Chung Jaedong *et al*., 1999; Bekheta and Ramadan, 2005; Mahgoub *et al*., 2006).

4.2. Node number

The number of nodes is one of the morphological factors that is less affected by environmental factors. This trait is less discussed, but studies show that it can have some effect on the number of sub-branches and crop production.

Table 2. Result analysis of variance of measured traits

S.O.V	df	Plant height	Node number	Node length	Stem number
Replication	2	2.41^{ns}	0.0001^{ns}	0.0001^{ns}	0.001^{ns}
Gibberline concentration (GC)	3	392.27**	27.10**	0.18*	70.46*
Growth stage (GS)	2	88.60**	12.30**	0.08*	0.53*
GC × GS	6	38.11**	9.55**	0.003*	0.66*
Error	22	2.35	0.0001	0.0001	0.033
CV (%)	-	9.74	7.10	9.63	10.44

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

Continue table 2.

S.O.V	df	Pod length	Seed yield	Stem dry weight	Leaf dry weight
Replication	2	0.04^{ns}	27630.32^{ns}	0.21^{ns}	0.44^{ns}
Gibberline concentration (GC)	3	6.90*	844221.83*	67996.05**	122039.42**
Growth stage (GS)	2	0.62*	87210.47*	881.12**	133225.87**
GC × GS	6	0.75*	68911.76*	409.85**	11315.66**
Error	22	0.016	27837.53	0.56	0.40
CV (%)	-	10.57	11.17	7.05	7.09

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

Result of analysis of variance revealed effects of different amount, time of apply Gibberellin acid and interaction effect of treatments on node number was significant at 1% probability level (Table 2). According result of mean comparison maximum of node number (26.56) was obtained for 50 ppm Gibberellin acid and minimum of that (22.16) was for control treatment (Table 3). It seems the number of nodes is a morphological trait, the concentration of 50 ppm hormone had the greatest effect on the number of nodes in the pre-flowering growth period, perhaps because this trait is less affected by the environment, the changes were not very noticeable. Evaluation mean comparison result indicated in different level of time of applies Gibberellin acid the maximum node number (25.53) was noted for vegetative growth before flowering and minimum of that (22.99) belonged to pod emergence until grain filing (Table 4). Assessment mean comparison result of interaction effect of treatments indicated maximum node number (29.35) was noted for 50 ppm and vegetative growth before flowering and lowest one (21) 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	Plant height (cm)	Node number	Node length (cm)	Stem number
5 ppm	79.33b*	25.05ab	3.40ab	11.44ab
50 ppm	88.55a	26.56a	4.07a	12.21a
250 ppm	79.84b	24.12ab	3.50ab	11.41ab
Control	71.64d	22.16b	3.36b	10.06b
LSD	0.57	0.78	0.50	0.56

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

Continue table 3.

Gibberline concentration	Pod length (cm)	Seed yield ($kg.ha^{-1}$)	Stem dry weight ($kg.ha^{-1}$)	Leaf dry weight ($kg.ha^{-1}$)
5 ppm	15.37ab*	2504b	1540c	721.1c
50 ppm	16.41a	2761a	1677a	916.1a
250 ppm	15.58ab	2365c	1607b	810.2b
Control	14.47b	1983d	1493d	543.3d
LSD	0.24	55.1	70.73	80.62

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

These results were consistent with the finding of Abdul and Said (1984), who stated that gibberellin acid had an effect on the number of nodes.

4.3. Node length

According result of analysis of variance effect of different amount, time of applies Gibberellin acid and interaction effect of treatments on node length was significant at 5% probability level (Table 2). Assessment mean comparison result indicated in different level of Gibberellin acid concentration the maximum node length (4.07 cm) was noted for 50 ppm Gibberellin acid and minimum of that (3.36 cm) belonged to control treatment (Table 3). Because there was no obvious difference in the effect of gibberellin acid on the length of internodes, it can be said that because this trait is morphological, it has less effect on the environment, but because the concentration of 50 ppm in the vegetative growth period before flowering compared to other treatments and periods It produced the highest node length, so if the bean plant receives the hormone gibberellin acid during the growing period before flowering, the positive effect on the internode height will be greater. Compare different level of time of applies Gibberellin acid showed that the maximum and the minimum amount of node length belonged to vegetative growth before flowering (4.01 cm) and pod emergence until grain filing (3.35 cm) treatments (Table 4).

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

Time of application Gibberline	Plant height (cm)	Node number	Node length (cm)	Stem number
Vegetative growth before flowering	82.29a*	25.53a	4.01a	12.01a
Flowering until pod emergence	80.43ab	23.90ab	3.47b	11.14ab
Pod emergence until grain filing	76.80b	22.99b	3.35b	10.68b
LSD	1.20	0.89	0.12	0.54

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

Continue table 4.

Time of application Gibberline	Pod length (cm)	Seed yield ($kg.ha^{-1}$)	Stem dry weight ($kg.ha^{-1}$)	Leaf dry weight ($kg.ha^{-1}$)
Vegetative growth before flowering	16.19a*	2478a	1627a	773.80a
Flowering until pod emergence	15.40b	2399ab	1606b	741.20ab
Pod emergence until grain filing	14.79c	2330b	1522c	727.50b
LSD	0.41	59.3	22.31	12.54

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

Evaluation mean comparison result of interaction effect of treatments indicated maximum node length (4.98 cm) was noted for 50 ppm and vegetative growth before flowering and lowest one (3.28 cm) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5). Some researchers such as Ngatia *et al*. (2004); Baninasab and Rahemi (1998); Moalemi *et al*. (2009) reported growth hormone are effective in cell division and cell elongation, and sub-branches of nodes are formed. The more space and number of nodes there are the more effective the number of nodes may be in function.

4.4. Stem number

The main stem of the bean has many lateral branches that usually occur from the bottom of the main stem, near the soil surface, this trait has a positive and significant correlation with grain yield. Result of analysis of variance revealed effects of different amount, time of apply Gibberellin acid and interaction effect of treatments on stem number was significant at 5% probability level (Table 2). Mean comparison result of different level of Gibberellin acid concentration indicated that maximum stem number (12.21) was noted for 50 ppm Gibberellin acid and minimum of that (10.06) 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 stem number belonged to Vegetative growth before flowering (12.01) and pod emergence until grain filing (10.68) (Table 4).

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

Gibberline concentration	Time of application Gibberline	Plant height (cm)	Node number	Node length (cm)	Stem number
5 ppm	Vegetative growth before flowering	78.32d*	25.46c	3.88c	12.01b
	Flowering until pod emergence	84.57c	25.93b	3.33h	11.37c
	Pod emergence until grain filing	75.10e	22.78e	3.30i	10.87d
50 ppm	Vegetative growth before flowering	91.46a	29.35a	4.98a	13.30a
	Flowering until pod emergence	86.84b	24.06c	3.68d	12.10b
	Pod emergence until grain filing	87.37b	25.27c	3.55e	11.23c
250 ppm	Vegetative growth before flowering	86.67b	24.33c	3.74b	12.53b
	Flowering until pod emergence	78.59d	23.13e	3.48f	11.00c
	Pod emergence until grain filing	74.27e	22.92ef	3.30k	10.72d
Control	Vegetative growth before flowering	72.74ef	23.00e	3.42g	10.20de
	Flowering until pod emergence	71.74ef	22.50ef	3.39g	10.10de
	Pod emergence until grain filing	70.46f	21.00f	3.28j	9.90f
LSD		1.10	1.17	0.05	0.18

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

Assessment mean comparison result of interaction effect of treatments indicated maximum stem number (13.30) was noted for 50 ppm and vegetative growth before flowering and lowest one (9.90) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5). Some researchers such as Daykin *et al*. (1997); Naeem *et al*. (2001); Ngatia *et al*. (2004) reported the effect of gibberellic hormone on the number of fertile stems of beans, it was stated that gibberellin acid will increase the fertile lateral stems in the plant and that the total yield is inversely proportional to the number of lateral stems.

4.5. Pod length

Pod length one of the morphological characteristics of bean plant is bean pods, cylindrical to wide, in field cultivars with a length of 5-10 cm and in garden cultivars up to 30 cm.

Continue table 5.

Gibberline concentration	Time of application Gibberline	Pod length (cm)	Seed yield (kg.ha^{-1})	Stem dry weight (kg.ha^{-1})	Leaf dry weight (kg.ha^{-1})
5 ppm	Vegetative growth before flowering	16.26b*	2532c	1578g	740.70g
	Flowering until pod emergence	15.25c	2510c	1533h	720.60h
	Pod emergence until grain filing	14.62d	2471bc	1510i	701.10i
50 ppm	Vegetative growth before flowering	17.79a	2899a	1693a	958.00a
	Flowering until pod emergence	16.33b	2736ab	1687b	900.50b
	Pod emergence until grain filing	15.11c	2650b	1651c	890.60c
250 ppm	Vegetative growth before flowering	16.04b	2451d	1631d	850.90d
	Flowering until pod emergence	15.37c	2345e	1600e	800.20e
	Pod emergence until grain filing	15.35c	2300e	1590f	780.50f
Control	Vegetative growth before flowering	14.68de	2030f	1499j	547.00j
	Flowering until pod emergence	14.65de	2021g	1492k	543.50k
	Pod emergence until grain filing	14.09e	1899h	1488l	540.20l
LSD		0.08	10.5	3.27	5.07

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

Because this trait is less discussed, but in studies, it was found that the trend of pod length changes was similar to the grain weight in the pod (Parsa, 1999). According result of analysis of variance effect of different amount, time of applies Gibberellin acid and interaction effect of treatments on pod length was significant at 5% probability level (Table 2). According result of mean comparison maximum of pod length (16.41 cm) was obtained for 50 ppm Gibberellin acid and minimum of that (14.47 cm) was for control treatment (Table 3). Evaluation mean comparison result indicated in different level of time of applies Gibberellin acid the maximum pod length (16.19 cm) was noted for vegeta-

tive growth before flowering and minimum of that (14.79 cm) belonged to pod emergence until grain filing (Table 4). Evaluation mean comparison result of interaction effect of treatments indicated maximum pod length (17.79 cm) was noted for 50 ppm and vegetative growth before flowering and lowest one (14.09 cm) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5). In current study of this trait, it can be said that the hormone gibberellic acid, with any concentration, was able to increase the pod length compared to the control treatment, without consuming the hormone. It may be fair to say that gibberellic hormone has an increasing effect on pod length, but different concentrations of gibberellic acid have not been able to make a significant difference in this trait. The mentioned result was consistent with the findings of Negatia *et al.* (2004); Eid *et al*. (1992), that reported gibberellic hormone has a positive effect on bean pod length.

4.6. 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 indicated 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). Assessment mean comparison result indicated in different level of Gibberellin acid concentration the 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). Compare different level of time of applies Gibberellin acid showed that the maximum and the minimum amount of seed yield belonged to vegetative growth before flowering (2478 $kg.ha^{-1}$) and pod emergence until grain filing (2330 $kg.ha^{-1}$) treatments (Table 4). Evaluation 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 (1899 $kg.ha^{-1}$) 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.

4.7. Stem dry weight

The leaves are a food factory in plants, the more leaves the plant will have the power to build higher production and will have an important effect

on increasing yield. The use of gibberellic acid can be effective due to its role in cell development (Alentok, 2019). According result of analysis of variance effect of different amount, time of applies Gibberellin acid and interaction effect of treatments on stem dry weight was significant at 1% probability level (Table 2). Mean comparison result of different level of Gibberellin acid concentration indicated that maximum stem dry weight (1677 kg.ha^{-1}) was noted for 50 ppm Gibberellin acid and minimum of that (1493 kg.ha^{-1}) 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 stem dry weight belonged to Vegetative growth before flowering (1627 kg.ha^{-1}) and pod emergence until grain filing (1522 kg.ha^{-1}) (Table 4). Assessment mean comparison result of interaction effect of treatments indicated maximum stem dry weight (1693 kg.ha^{-1}) was noted for 50 ppm and vegetative growth before flowering and lowest one (1488 kg.ha^{-1}) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5). Therefore, it can be said that the younger and fresher the leaf, the greater the effect of gibberellic acid on it. The leaves of plants that received the hormone gibberellic acid during the vegetative growth period before flowering had a greater chance of being affected by the hormone. Hormones also have a greater chance of having a higher effect on the plant. The mentioned result was similar to report of Hasanpor Asil *et al.* (2008) and Moalemi *et al.* (2009), they are stated the hormone of gibberellic acid is involved in leaf growth and development and consequently its final dry weight.

4.8. Leaf dry weight

The bean plant has a strong stem, smooth (without hairs) and leafy to a height of 180-30 cm. The stronger the stem, had more holding power. The strength of the stem should be such that it can hold the pods well, the hormone gibberellic acid in these cases has positive effects on the stem (Davies *et al.*, 2002). Result of analysis of variance showed effects of different amount, time of applies Gibberellin acid and interaction effect of treatments on leaf dry weight was significant at 1% probability level (Table 2). Mean comparison result of different level of Gibberellin acid concentration indicated that maximum leaf dry weight (916.10 kg.ha^{-1}) was noted for 50 ppm Gibberellin acid and minimum of that (543.30 kg.ha^{-1}) 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 dry weight belonged to Vegetative growth before flowering (773.80 kg.ha^{-1}) and pod emergence until grain filing (727.50 kg.ha^{-1}) (Table 4). Evaluation mean comparison result of interaction effect of treatments indicated maximum leaf dry weight (958 kg.ha^{-1}) was noted for 50 ppm and vegetative growth before flowering and lowest one (540.20 kg.ha^{-1}) belonged to nonuse of Gibberellin acid and pod emergence until grain filing (Table 5). The younger the stem, the greater the effect of gibberellic acid on

it. Because growth is not yet complete, the concentration that had the greatest effect was 50 ppm. It can also be said that although the concentration of 250 ppm was higher than the concentration of 50 ppm, due to the inhibition of gibberellic acid at high levels, this concentration did not have an additive effect on the stem as much as the concentration of 50 ppm. Hasanpor Asil *et al*. (2008) and Moalemi *et al*. (2009) reported similar result.

5. CONCLUSION

Finally according result of current study apply 50 ppm Gibberellin at vegetative growth before flowering had highest amount of studied traits and it can be advice to producers.

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FOOTNOTES

AUTHORS' CONTRIBUTION: All authors are equally involved.

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