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Research Article

EFFECT OF DIFFERENT GIBBERELLIC ACID HORMONE LEVELS ON YIELD AND YIELD COMPONENTS OF WHEAT CULTIVARS

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ABSTRACT
The study was done in order to evaluate the effect of 3 different wheat cultivars and 3 level of Gibberellic acid addition on dynamics growth and wheat produce factors in the year 2012-2013. This experiment was performed in split plot with RCDB design with 3 replications in ShahidSalemi research field in Ahvaz. Main plots included 3 GA levels (G0=0ppm،G1=150ppm و G2=250ppm) and subplots included 3 wheat cultivars (V1: Chamran, V2: Varinak, V3: Star). Results showed that application of 250ppm GA hormone could produce 789 gr/m2 that was seed yield maximum and control could produce 683gr/ m2 that were seed yield minimum. Biological yield maximum (2468 gr/m2) and minimum (2272 gr/m2) were obtained in 250ppm hormone application and control, respectively. Biological yield procedure in this study showed that GA hormone using results in plant growth increasing and amount of this trait is increased by GA level increasing.

Keywords: *Wheat, GA Hormone, Yield and Yield Components*

INTRODUCTION
According to studies by researchers in worldwide, 50 different Giberline types were discovered, up to now. Each one was determined by number over than 1. The most famous Giberline is "Giberlic acid" which is present in majority of plants. Determined Giberline can be divided into 2 groups: C_{20} and C_{19}, that first group has 2 carboxilic group, without lactonic cycle, and the second one has one carboxylic and one lactonic cycle (Alazemni and Ghorbanly, 2009). All studied plants up to now had at least one type Giberline and most of them several Giberline. Giberline produce centers in plants are: stem terminal, root active parts, young leaves, growing fruit and particularly, growing seeds (Tavili *et al.,* 2009).
Likes Auxin, Giberlines control almost all growth physiological processes and plant germination predominant Giberline effect is increase in plant growth by stem internode elongation (Baloochi *et al.,* 2006).
Nadejfi *et al.,* (2006) reported that among studied hormones, GA controls seed dormancy by germination introduce.
Pan *et al.,* (2013) reported that higher wheat seed yield when GA using, was related to more increase in spikelet number, seed number and seed filling percentage. Ehdaei and Waines (1989) observed that in wheat, average 1000 seeds weight is reduced under environmental condition after flowering. Kobata *et al.,* (1992) statethat wheat seed weight reduction is due to water availability reduction assimilate translocation reduction toward spike. Wang and Zhou (1996) said that reason of wheat seed weight reduction is acceleration in senescence and photosynthesis capacity reduction. Trethowan *et al.,* (2002) demonstrated that reduction of spike number per area unit and seed number per spike, acceleration in growth and development stages and reduction of their stability, biological yield reduction, plant height, spike length and 1000 seeds weight are important factors in wheat yield reduction.

MATERIALS AND METHODS
Experimental Location
This study was done in Shahid Salemi in Ahvaz at latitude 31°20´N and longitude 48°40´E, with 22.5 m height from sea, in 2012-2013. Soil of this place was loam-clay, ph=8.7 and EC=5ds/m. In this investigation main plot and subplot were G hormone including (3 levels: G0 = 0 ppm, G1: 15 ppm and

G_2= 25 ppm) and wheat cultivars (V_1= Chamran, V_2= Varinak, V_3= Star) (intotal, treatmants) respectively.

Experiment was performed in an area of 1200 m^2 as split plot with RCDB design with 4 replications (in total 36 experimental plots). Fertilizers requirement were determined related to soil test and based on it 100kg N fertilizer as base fertilizer and remains75kg N was added in tillering and wheat stem stages 100kg/ha P fertilizer from super phosphate triple was used as base was determined for each plot and seed was planting manually and uniformly. Irrigation was done after cultivation, immediately. 33 day after planting hormone was sprayed by 20 lit sprayers. In order to study of plant growth procedure and requirement parameters were measured during growing season. 6 times in each sampling with considering boarder cultivation lines, plants were harvested from main cultivation lines an order to calculating seed yield final harvest was done at seed physiological maturing and by considering boarder effect, plants in an area 2 m^2 in each plot were harvested by hand.

RESULTS AND DISCUSSION

Number of Spike Perm²

Result showed that effect of GA hormone and cultivar had significant difference at 5% lead level, respectively (table 1). Maximum of NO of spike per m2 was obtained from 225 ppm hormone (1045 spikes) and 150 ppm hormone (99/spikes) that both had significant difference in compare with control (978 spikes), where illustrated effect of hormone on this trait (table 2) study of cultivar mean showed that maximum 1024 and minimum 978 NO of spikes per m2 were related to Chamran and Star, respectively (table 3). High spikes number of Chamran is due to ability of this cultivar in using of conditions and its high produce potential. Hormone and cultivar interaction showed that. Varinak in 250 ppm GA hormone concentration (1/73) and in Star cultivar in control treatment (9.4) were maximum and minimum respectively (Table 4). Wheat higher seed yield when GA was used is due to increasing in spikelet in spike, No of seed and geain filling percentage (Pan *et al.,* 2013).

Spikelet Number per Spike

According to result the effect of cultivars had no significant different. But hormone and cultivar interaction was significant at 5% (Table 1). 250 ppm concentration (15 spike lets) and 150 ppm concentration (13 spike lets) were maximum and minimum number of spikeslet per spike that both of them in compared with control (11 spike lets) had effectively effect and was indicated that use of GA hormone and therefore hormone concentration increasing resulted in increasing in spikelet per spike (Table 2). Among the different cultivars didn't observed any significant difference that is due to their similar ability and produce potential (Table 3). Evaluation of hormone and cultivar interaction showed that Chamran cultivar in 250 ppm concentration produced 14 spikelet per spike (maximum) and Varinak in 150 ppm concentration produced 12 spikelet per spike(minimum), so, increasing in amount of hormone is resulted in increasing spikelet per spike (Table 4) (Dong *et al.,* 2009). Zahir *et al.,* (2007) in their experiment showed that using GA with compost suplemontal with by nitrogen in compared with using 120kg/ha nitrogen fertilizer and suplemontal with compost by 60 kg/ha nitrogen fertilizer had no significant difference by number of spikelet per spike (Approximately 14 spikelet per spike).

Seed Number per Spikelet

According to ANOVA results, using GA hormone and cultivar their interaction had significant difference at 5% level (Table 1). Maximum of seed number per spikelet (2 seeds) and its minimum (1 seed) were obtained when 250 ppm hormone and in control, respectively (Table 2). Using GA hormone increases seed number per spikelet and illustrates that probably results in filling resources. Chamran cultivar with most seed had maximum of this trait and Varinak and star had no significant difference in this trait (Table 3). According to treatment interaction, GA hormone in different concentration had different effects on studied cultivars that in all cultivars increasing in hormone concentration was due to increasing in seed number per spikelet and Chamran cultivar had maximum of this trait. Maximum of seed number per spikelet (1.87) was obtained when 250 ppm hormone was used and minimum seed number (1.33) was obtained in star cultivar and control treatment (Table 4). Pan *et al.,* (2013) reported that higher seed yield is due to increasing number of spikelet in spike, seed number and seed filling percentage when GA is used in wheat.

Seed Number per Spike

Effect of different GA hormone levels on seed number per spike had no significant difference and diversity cultivar at 5% level and their interaction at 1% level were significantly different (Table 1). Studying of effect of different hormone levels had no significant difference. Maximum (23) and minimum (19) of seed per spike were dedicated to Chamran, and Varinak and Star cultivars, respectively (Table 3). Evaluation of hormone and cultivar interaction showed that Chamran cultivar with 25 seeds in 150 and 250 ppm hormone concentration and Varinak and Star cultivars with 18 seeds per spike were maximum and minimum, respectively and seed number per spike was increased by increasing hormone concentration (Table4). Tavakoli (2003) reported that seed formation per spike potential formed before flowering and in stages after stem producing by effect on fertilization can increase seed number per spike. Abdemshani and JafariShabestari (1997) believe that seed number per spike dependents on spike length is due to genetics and environmental factors during growing season. Chamran cultivar had seeds per spike less than Varinak and Star cultivar and its reason is spike number per area increasing in compared with these 2 cultivars. This result was consistent with the findings of Wells and Dubets (1998). As seed number per spike is one of yield component and dependent on cultivar growing conditions, to obtain high seed number per spike should pay attention to genetics characteristics related to flexibility and maturing situation.

Seed number per m2

Results related to Seed number in m^2 showed that effect of different GA hormone concentration, cultivar and their interaction were significant at 1% level (Table 5). Maximum of Seed number in m^2 (21938) and its minimum (19550) were obtained from 250 ppm and control treatments that had no significant different with 150 ppm (20347 Seed number in m^2). Evaluation of this trait showed additional effect of different concentrations on Seed number in m^2 by hormone addition (Table 6). Among cultivars Chamran and Star cultivars had maximum (23761) and minimum (18325) Seed number in m^2. Results of cultivar diversity investigation illustrates that Chamran has high ability in usage of produce potential rather than Varinakans Star cultivars (Table 7). Study of hormone and cultivar interaction determined that Seed number maximum was related to Chamran treated by 150 (26450 seeds) and 250 ppm (25654 seeds) that there wasn't significant difference between them and Seed number minimum was related to Varinak (16560seeds) and Star (16072 seeds) that wasn't significant difference between them, too (Table 8).

1000 Seeds Weight

1000 seeds weight data showed that GA hormone treatment had no effect on it, but cultivars and treatment interaction had significant difference at 1% probability level (Table 5). 1000 seeds weight maximum (36gr) in different hormone level and minimum (35gr) in control were obtained that had no significant different (Table 6). There was no significant difference between Chamran cultivar with 38gr (highest 1000 seeds weight) and Varinak with 34gr and Star with 35gr (lowest 1000 seeds weight) (Table 7). Chamran cultivar in all hormone levels did not affected by hormone also hormone increasing was not due to 1000 seeds weight significantly increasing in Chamran cultivar that had 1000 seeds weight maximum (38gr) in 150 and 250 ppm concentration and 1000 seeds weight minimum was related to Varinak and Star cultivars with 33gr (Table 8).

According to Bahari *et al.,* (1386) results reduction of 1000 seeds weight is due to reduction of photosynthesis in wheat. Considerable amount of seeds weight in seed filling period is supply by current photosynthesis. In seed filling period, current photosynthesis reduction results in seeds weight decrease. 1000 seeds weight is the last one of yield components that determined and it is the only yield components that dependent on environmental conditions after flowering. Ehdaie and Waines (1989) observed that average 1000 seeds weight was reduced under environmental conditions after flowering in wheat; also, they found that there was genetic difference by reduction of 1000 seeds weight in studied wheat genotypes. Sarmadnia (1993) believes that average wheat seed weight takes part in total yield as well as spike number per area unit. Wang & Zhou (1996) said that reason of seed weight reduction was plant senescence acceleration and photosynthesis capacity reduction. These results were consistent with this investigation finding. 1000 seeds weight changes were matched with seed number per spike and spike number per area unit. This can showed condition effect on yield components formation (Guttieri *et al.*, 2001).

Seed Yield

Effect of different GA hormone concentration, cultivar and their interaction on seed yield was significant at 1% (Table 5). 250 ppm GA using with 789 gr/m^2 and control with 683gr/m^2 were seed yield maximum and minimum, respectively. Evaluation of GA effect on seed yield showed that using this hormone and its increasing caused increased seed yield that it positive and addition effect on yield components (Table 6). Seed yield maximum and minimum were related to Chamran (895 gr/m^2), and Star (643gr/m^2) and Varinak (651gr/m^2) that there was no significant difference between them. This result showed that Cahmran cultivar under GA hormone usage condition has higher potential by seed production and followed yield components and it can be said hormone effect on Chamran was more than on 2 other cultivars by yield increasing and ability and plant potential increasing to use condition and current resources (Table 7). Also, seed yield maximum in 250ppm was obtained by Chamran (1008 gr/m^2) and its minimum was obtained by Star (533 gr/m^2) and Varinak (546 gr/m^2) that had no significant different (Table 8). Seed yield affects by genetically, physiologically and environmental factors. Machado *et al.*, (1993) in their research found that there is significant difference among different cultivars by this trait. Derara *et al.*, (1969) by research on cereal such as wheat, barley and corn in international centers (CYMMIT and ICARDA) reported that seed yield depends on seed number more than seed weight, so researches are focus on during flowering condition (when seed number is formed). Wang *et al.*, (1996) found that the most sensitive stage is spike formation to flowering interval and tolerance variety can produce high biomass and restore high assimilate stem. Spike number per area unit and seed number per spike reduction, acceleration in growth and development stages and reduction of their stability, biological yield reduction, plant height, spike length and 1000 seeds weight are important factors in wheat yield reduction (Trethowan *et al.*, 2002). Plant growth regulators, especially GA have important role in growth, development, yield and quality on formation (Ekamber and Kumar, 2007; Rajendra and Jones, 2009). Zheng *et al.*, (2011) showed that appropriate plant growth regulators, likes GA usage can improve photosynthesis capacity, leaf senescence delaying and seed number increasing. Pan *et al.*, (2013) reported that plant growth regulator spray has considerable effects on seed quality. Shaddad *et al.*, (2013) reported that most of the time, GA had inhibitor effect on leaf area and pigment photosynthesis in salt stress, especially in 50mM. Zahir *et al.*, (2007) in their study showed that GA and compost treatment with 60kg/ha urea fertilizer had no significant difference in seed yield that produced 4 ton/ha yield. Shaddad *et al.*, (2013) reported that GA as plant growth regulator increases wheat growth adaptability in salt condition. Also, they said GA usage reduces salt stress inhibitor on wheat seed yield cultivars, but causes yield production increase.

Conclusion

In general results showed that usage of the hormone giberelic acid effects on seed yield, yield components percentage. Study of different hormone levels showed that the use of hormone not only can improved attributes compared with control, but also it can create increasing procedure in trait through increase in the use of hormone. The result indicate that use of 250 ppm hormone cause to increase in yield, yield components and other attributes compare to 150 ppm hormone. Both treatments compare to control cause to improve and enhance in these features and traits. This increase in traits is probably due to the activity of this type of growth hormone. Gibberellic acid also effects on increasing the number of spikelets (sinks) and regarding to cells enlarging and increased leaf area that lead to create more photosynthesis products and the positive effect that this hormone has on seed and plant weight probably because of existence of more magazine and facilitating assimilate transition lead to higher seed yield. Evaluation of different kind of wheat cultivars in this study showed Chamran cultivar compared to the Varinak and Star cultivars Superior in terms of yield components and has higher potential and ability that resulting in greater seed yield on it. Of course this Superiority is probably due to the wider range of compatibility this cultivar to environmental conditions and better usage of current resources. Interaction between treatments showed that use of 250 ppm gibberellic acid hormone in Chamran cultivar compare to use of 150 ppm hormones lead to increase in seed yield and increase in yield components Indicating an increase trend in traits and seed yield that both of these treatments compare to control lead to increasing in seed yield by means of increscent in effective seed component yield.

Table1: Results of ANOVA of mean square average of studied traits in wheat

S.O.V	df	No. of spikelet per spike	No. of seed per spikelet	No. of seed per spike	No. spike per m^2
R	3	11.67^{ns}	2.54^{ns}	17.02^{ns}	151.73^{ns}
GA hormone	2	39.3*	5.64*	20.64^{ns}	310.27*
E(a)	6	14.94	1.13	16.19	148.46
Cultivar	2	19.3^{ns}	4.82*	27.87*	330.58*
Interaction	4	33.46*	4.57*	43.87**	445.29**
Error	18	13.86	1.77	13.93	154.68
(CV%)		10.93	10.28	6.53	9.38

*Ns, *, ** respectively indicate non-significant difference and significant difference at 1% and 5% levels*

Table 2: mean comparison of the traits related to effect of GA hormone on wheat traits

GA hormone	No. of spikelet per spike	No. of seed per spikelet	No. of seed per spike	No. spike per m^2
Control	11^c	1^c	20^a	978^c
150ppm	13^b	1.5^b	21^a	991^b
250ppm	15^a	2^a	21^a	1045^a

According to Duncan's multi range test the means with similar letters in each column are not significantly different at 5% level

Table 3: mean comparison of the traits related to different wheat cultivars

Cultivar	No. of spikelet per spike	No. of seed per spikelet	No. of seed per spike	No. spike per m^2
Chamran	13^a	2^a	23^a	1024^a
Verinak	13^a	1^b	19^b	1012^a
Star	13^a	1^b	19^b	978^b

According to Duncan's multi range test the means with similar letters in each column are not significantly different at 5% level

Table 4: Results of studied traits mean comparison in different wheat cultivars under GA hormone using intraction

S.O.V.	df	No. of spikelet per spike	No. of seed per spikelet	No. of seed per spike	No. spike per m^2
	Chamran	13^b	1.63^{bc}	21^b	950^{cd}
Control	Varinak	13^b	1.44^e	18^d	920^{de}
	Star	13^b	1.33^g	18^d	904^e
	Chamran	13^b	1.73^{ab}	25^a	1027^b
150ppm	Varinak	13^b	1.51^{de}	19^{cd}	979^c
	Star	13^b	1.34^g	19^d	986^c
	Chamran	14^a	1.87^a	25^a	1058^b
250ppm	Varinak	12^c	1.57^{cd}	20^{bc}	1173^a
	Star	13^b	1.35g	21^b	1046^b

According to Duncan's multi range test the means with similar letters in each column are not significantly different at 5% level

Table 5: summarizes the analysis of variance mean squares for all traits in wheat

S.O.V	df	Seed number per m^2	1000seeds weight	Seed yield
R	3	3184.89^{ns}	21.41^{ns}	309.67^{ns}
GA hormone	2	7934.27**	26.41^{ns}	582.27**
E(a)	6	2372.61	19.61	234.94
Cultivar	2	6382.62**	35.33**	304.12**
Interaction	4	6035.78**	34.19**	486.72**
Error	18	2183.9	16.54	214.86
(CV%)			11.93	10.93

*Ns, *, ** respectively indicate non-significant difference and significant difference at 1% and 5% levels*

Table 6: The results of the comparison of traits in wheat affected by application of gibberellic acid hormone

GA hormone	Seed number per m^2	1000seeds weight	Seed yield
Control	19550^b	35^a	683^c
150ppm	20347^b	36^a	722^b
250ppm	21938^a	36^a	789^a

Table 7: The results of the comparison of traits in wheat varieties

Cultivar	Seed number per m^2	1000seeds weight	Seed yield
Chamran	23761^a	38^a	895^a
Varinak	19326^b	34^b	651^b
Star	18325^c	35^b	643^b

According to Duncan's multi range test the means with similar letters in each column are not significantly different at 5% level

Table 8: The results of the comparison traits in wheat varieties under the effect of the hormone gibberellic acid intraction

GA hormone	Cultivar	Seed number per m^2	1000seeds weight	Seed yield
Control	Chamran	19950^c	37^a	738^c
	Varinak	16560^{ef}	33^c	546^e
	Star	16072^f	33^c	533^e
150ppm	Chamran	25654^a	38^a	975^b
	Varinak	18622^d	34^c	633^d
	Star	17321^e	36a^b	624^d
250ppm	Chamran	26450^a	38^a	1008^a
	Varinak	23460^b	34b^c	796^c
	Star	18819^d	36a^b	676^d

According to Duncan's multi range test the means with similar letters in each column are not significantly different at 5% level.

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