

# Interactive Effect of Growth Regulators and Fertilizers on Yield, Chlorophyll and Ascorbic Acid Content of Barley Plants

## Abstract

Increase in level of GA and IAA increased dry matter yield of Barley (*Hordeum bulgare* L. var. K-329) plants. GA was however, found more beneficial as compared to IAA. Maximum dry matter yield of both tops and grains, and chlorophyll content in leaves of barley plants was observed, at 5 ppm GA. 1 ppm GA showed maximum ascorbic acid content of tops of barley plants. Interaction 25 ppm GA x F8 in tops and 5 ppm GA x F8 in grains for dry matter yield, 5 ppm GA x F5 for chlorophyll and 5 ppm GA x F4 for ascorbic acid content was found to be best.

**Keywords:** GA, IAA, Fertilizer, Barley.

## Introduction

Growth of a plant has for long time being believed to be due to the minerals (absorb from the soil) and food material synthesized by the plants. It is now however recognized that plant growth is very much regulated in the natural course by certain substances which are synthesized by the plants. These substances are often referred to plant hormones, growth hormones, growth regulators and phytohormone etc. plant regulators are define as organic compound other than nutrients which in small amount promotes, inhibits or otherwise modify any physiological process.

## Review of Literature

Robinson (1975) Mohan (1983) has stated that beneficial interaction between growth regulators and higher level fertilizer application may be of practical significance. The work on action of IAA has been evaluated by a number of worker Bayer and Morgan (1970), *lianet al.* (1971), Kaldenoy and Wakhlar (1972), Hemberg Larsson (1972) and Robinson (1975). The work on action of Gibberellins on plants has been evaluated by a number of workers such as Randhawa and Dass (1976), Sinha and Mohan (1978) and Mohan and Sinha (1988) This paper deals with the interactive effect of GA and IAA with different forms of fertilizer on yield, chlorophyll and ascorbic acid content of barley plants.

## Aim of the Study

The aim of the study is to check the interactive Effect of Growth Regulators and Fertilizers on Yield, Chlorophyll and Ascorbic Acid Content of Barley Plants.

## Material and Methods

Barley (*Hordeum bulgare* L. var. K-329) plants were raised in acid washed white silica and under pot culture condition using technique standardized for Indian condition by Agarwala and Sharma (1976). Diluted full nutrient solution containing 8 meq/l Ca as CaSO<sub>4</sub>; 4 meq / l K as K<sub>2</sub>SO<sub>4</sub>; 4 meq / l Mg as MgSO<sub>4</sub>; 4 meq / l P as NaH<sub>2</sub>PO<sub>4</sub>; 16 meq / l S as sulphates of Ca, K and Mg; 1.3 meq / l Na as NaH<sub>2</sub>PO<sub>4</sub>; 5.6 ppm Fe as Ferric citrate; 6.55 ppm Mn as MnSO<sub>4</sub>; 0.065 ppm Cu as CuSO<sub>4</sub>; 0.065 ppm Zn as ZnSO<sub>4</sub>; 0.05 ppm Mo as Na<sub>2</sub>MoO<sub>4</sub>; 0.37 ppm b as H<sub>3</sub>BO<sub>3</sub>; 0.006 ppm Co as CoSO<sub>4</sub>; 0.06 ppm Ni as NiSO<sub>4</sub> as described earlier by Mohan *et al.*(1982) and different fertilizer levels used were as under:

1. Diluted full nutrient solution (F1)
2. Diluted full nutrient solution 12 meq / l N (F2)
3. Diluted full nutrient solution 4 meq / l P (F3)
4. Diluted full nutrient solution 4 meq / l K (F4)
5. Diluted full nutrient solution 12 meq / l N  
Diluted full nutrient solution + 4 meq / l P (F5)
6. Diluted full nutrient solution 12 meq / l N  
Diluted full nutrient solution + 4 meq / l K (F6)
7. Diluted full nutrient solution 4 meq / l P

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Diluted full nutrient solution + 4 meq / I K  
(F7)

8. Diluted full nutrient solution 12 meq / I N  
Diluted full nutrient solution + 4meq / I P  
Diluted full nutrient solution + 4meq / I K  
(F8)

With each supply of fertilizer, after emergence of seedlings, at weekly intervals the pods were spray with 25 ml portion of nil (control), 1, 5 and 25 ppm GA and 1, 5 and 25 ppm IAA in form of aqueous solution. In control 25 ml distilled water per pot was spray, details of determination of yield and estimation of chlorophyll and ascorbic acid content were same as described earlier by Katiyar (1990).

#### **Result and Discussion (Table 1 and 2)**

Effect of graded levels of GA and IAA on growth, ascorbic acid and chlorophyll content, of barley (*Hordeum vulgare*, L. Var. K-329) plants raised in soil culture with different doses of fertilizers.

#### **Dry Matter Yield**

GA and IAA increased the dry matter yield of both tops of 30 days old plants and grains of 120 days old barley plants. 5 ppm GA showed maximum value for dry matter yield of both tops and grains and this increase over control, in both tops and grains was found to be highly significant ( $P=0.01$ )

F8 fertilizer supply showed maximum and highly significant ( $P=0.01$ ) increase in dry matter yield of both top and grain over control. Value at F2 with F3 and F5 with F8 fertilizer supply in tops and F3 with F7 fertilizer apply in grains were found to be almost similar.

Interactions 25 ppm GA x F8 in tops and 5 ppm GA x F8 in grains found maximum value for dry matter yield and these value were found to be significantly ( $P=0.05$ ) higher over interaction, 1 ppm GA x F8, 1 ppm IAA x F8, 5 ppm IAA x F8 and 25 IAA x F8, and highly ( $P=0.01$ ) higher then rest of the interactions, except interactions 5 ppm GA x F8 in tops and 5 ppm GA x F5 in grains, where values fails to reach the level of significance.

#### **Ascorbic Acid**

All the level of GA and IAA treated increased the ascorbic acid content of tops 30 days old barley plants. 1 ppm GA showed maximum value for ascorbic acid content and this value was found to be highly significantly ( $P=0.01$ ) higher than control and all other treatment levels of GA and IAA.

F8 fertilizer supply showed maximum value of ascorbic acid content and this value was found to be highly significantly ( $P=0.01$ ) higher than all other forms of fertilizer supply. However values at F2 and F3 and F6 fertilizer supply were found to be similar.

Maximum value of ascorbic acid content was observed at interaction, 5 ppm GA x F5 and it differs highly significantly ( $P=0.01$ ) with value at all other interaction, except interactions 25 ppm GA x F5 and 1 ppm GA x F8, where values fails to reach the level of significance.

#### **Chlorophyll**

Overall, 5 ppm GA showed maximum increase in chlorophyll content in leaves of 30 days old barley plants. This increase was found to be highly significantly ( $P=0.01$ ) higher than control and rest of

the treatment levels, except 1 ppm IAA where values fails to reach the level significance. However, over control 25 ppm IAA showed highly significant ( $P=0.01$ ) decrease in chlorophyll content

F2, F4 and F5 fertilizer supply showed similar value for chlorophyll content and this value was found to be highly significantly ( $P=0.01$ ) higher than value at control. However F6 and F7 fertilizer supply showed highly significant ( $P=0.01$ ) decrease in chlorophyll content over control.

Interactions 5 ppm GA x F4 and 5 ppm IAA x F4 showed similar as well as maximum value for chlorophyll content, and this value was found to be significantly ( $P=0.01$ ) higher than value at interaction 5 ppm GA x F2, 1 ppm IAA x F2, control x F4, 1 ppm GA x F4, 25 ppm GA x F4, 5 ppm GA x F5, 25 ppm IAA x F5, 5 ppm IAA x F5 and 1 ppm GA x F8 and highly significantly ( $P=0.01$ ) higher than value at rest of the interactions, except at interaction 1 ppm GA x F2, where value fails to reach the level of significance.

#### **Discussion**

The increase in yield at lower levels of GA mainly maximum value up to 5 ppm are in accordance with the finding of Sinha and Mohan (1977, 1978 and 1979), Mohan and Sinha (1978), Saraswati *et al.* (1980), Mohan *et al.* (1982), Mohan *et al.* (1986), Mohan and Sinha (1988) and Katiyar and Mohan (1989). Tsukamoto *et al.* (1960) and Rappaport and Singh (1961) have also reported that the concentration of GA below 5 ppm appears safe.

Establishment of a balance between concentration of GA and IAA spray and minimum possible spray for different genotypes for obtaining best result needs further investigation

Increase in fertilizer supply increase the yield of plants. This is in conformity with the results obtained by Mazar and Somoczyhnka (1985), Baginekaset *et al.* (1986). Chen *et al.* (1986), Kulakovskaya (1986) Kasana and Ropal (1986), Mendalet *et al.* (1986), Zhukov and Filippov (1986).

The general interaction 5 ppm GA x F8 fertilizer supply showed maximum value for dry matter yield of tops and grains of barley plants. The results are in conformity with the findings of Mohan *et al.* (1980). Robinson (1975) has also stated the beneficial interaction between growth regulators and high levels of fertilizer application may be of practical significance.

It may be suggested that use GA spray along with biofertilizers (Blue green algae and *Azolla*) which are reported to fix atmospheric N for paddy may be of great economic value.

GA and IAA increases chlorophyll content with 5 ppm GA in barley plants, is in conformity with the findings of Mohan *et al.* (1980), Sharma (1980), Mohan (1988), Katiyaret *et al.* (1988), Mohan and Sinha (1988a). Interactions 5 ppm GA x F4 in barley, showed maximum chlorophyll content, the results are in conformity with the finding of Mohan (1983) and Mohan (1988).

Ascorbic acid content of tops of barley at 1 ppm GA was found to be maximum. This increase in ascorbic acid content of plants is in conformity with the findings of Pyshaleva (1974), Kumar *et al.* (1975),

Rao *et al.* (1976), who reported increase in ascorbic acid content even at and beyond 25 ppm GA supply.

Interaction 5 ppm GA x F5 in barley showed maximum ascorbic acid content. The results are similar with the findings of Mohan (1983, 1988).

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**Table : 1**  
**Interactive Effect Growth of Growth Regulators and Fertilizers on Dry Matter Yield of Barley Plants Raised in Sand Culture**

Fertilizer Supply	Control	ppm spray						Mean	
		GA			IAA				
		1	5	25	1	5	25		
<b>g DRY MATTER YIELD / PLANTS (TOPS)</b>									
F1	0.103	0.113	0.120	0.127	0.113	0.110	0.113	0.114	
F2	0.117	0.133	0.167	0.137	0.123	0.127	0.133	0.134	
F3	0.130	0.130	0.157	0.133	0.137	0.137	0.113	0.134	
F4	0.117	0.130	0.137	0.137	0.127	0.133	0.120	0.129	
F5	0.190	0.147	0.157	0.140	0.137	0.130	0.123	0.146	
F6	0.167	0.180	0.167	0.140	0.167	0.167	0.147	0.162	
F7	0.133	0.150	0.153	0.157	0.147	0.147	0.143	0.147	
F8	0.213	0.250	0.257	0.263	0.237	0.247	0.247	0.245	
Mean	0.146	0.154	0.164	0.154	0.148	0.150	0.143		
							LSD at	P=0.05	P=0.01
FOR FERTILIZER SUPPLY :								0.005	0.006
FOR GA AND IAA :								0.004	0.005
FOR INTERACTION :								0.011	0.015
<b>g DRY MATTER YIELD / PLANTS (GRAINS)</b>									
F1	0.620	0.937	0.993	0.700	0.710	0.827	0.680	0.781	
F2	0.637	0.630	0.687	0.883	0.623	0.633	0.700	0.685	
F3	0.763	0.830	0.873	0.763	0.810	0.827	0.750	0.802	
F4	0.717	0.847	0.885	0.747	0.753	0.777	0.723	0.774	
F5	0.977	0.980	1.033	0.840	0.750	0.980	0.810	0.910	
F6	0.960	0.983	0.973	0.777	0.873	0.913	0.767	0.864	
F7	0.827	0.893	0.853	0.770	0.760	0.793	0.757	0.808	
F8	0.990	1.013	1.070	0.927	0.907	0.900	0.860	0.952	
Mean	0.786	0.889	0.917	0.801	0.773	0.831	0.756		
							LSD at	P=0.05	P=0.01
FOR FERTILIZER SUPPLY :								0.020	0.026
FOR GA AND IAA :								0.017	0.023
FOR INTERACTION :								0.049	0.065

Table : 2

Interactive Effect Growth of Growth Regulators and Fertilizers on Ascorbic Acid and Chlorophyll Content of Barley Plants Raised in Sand Culture

Fertilizer Supply	Control	ppm spray							Mean
		GA			IAA				
		1	5	25	1	5	25		
mg ASCORBIC ACID / 100 g F.W.									
F1	23	29	30	31	27	27	29	28	
F2	29	38	37	40	31	36	39	36	
F3	30	41	38	39	36	34	36	36	
F4	30	42	33	33	40	38	31	35	
F5	37	42	46	45	42	42	43	42	
F6	30	37	43	36	34	40	36	36	
F7	33	39	34	32	37	33	30	34	
F8	36	45	38	32	42	38	36	38	
Mean	31	39	37	36	36	36	35		
							LSD at	P=0.05	P=0.01
FOR FERTILIZER SUPPLY :							1	2	
FOR GA AND IAA :							1.12	1.48	
FOR INTERACTION :							3	4	
mg CHLOROPHYLL / 100 g F.W.									
F1	12	16	17	18	13	18	15	15	
F2	19	22	20	17	19	18	16	19	
F3	17	18	17	18	17	16	17	17	
F4	19	19	23	20	18	23	15	19	
F5	18	18	20	20	16	19	19	19	
F6	14	14	15	16	13	17	13	1412	
F7	10	13	13	13	13	12	12	15	
F8	18	19	16	13	17	13	12		
Mean	16	17	18	17	16	17	15		
							LSD at	P=0.05	P=0.01
FOR FERTILIZER SUPPLY :							0.7	1.0	
FOR GA AND IAA :							0.6	0.8	
FOR INTERACTION :							2	3	