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Growth and Yield of Barley Plants in Relation to Gibberelic Acid under Calcareous Soils Conditions

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Abstract. A greenhouse study on the effect of GA on barley cv. 121 indicated that spraying plants with 50 ppm GA increased grain yield and its components. In contrast, spraying with 100 ppm GA vigorously increased plant height (lodging), number of total tillers, dry weight of the shoots and the yield of straw, while grain yield and the weight of 1000 grains significantly decreased. Therefore, the 100 ppm GA treatment was considered excessive.

It also seems that the proper time for spraying barley plants with 50 ppm GA is at the second leaf stage, whereas afterwards GA prolonged the vegetative phase of the plant.

Introduction

It has been established, as a result of numerous studies, that gibberellins are growth regulators with pronounced stimulating effect on plant growth. Many authors have proved that the most dramatic effect of GA is its ability to stimulate the growth of stem, plant branching and dry weight of top plant [1-5].

Singh and Dara [6] reported that 50 ppm GA increased the grain yield of wheat, whereas more than 100 ppm had no effect. Meanwhile, Schmalz and Mettin [7] found that the tested barley varieties were sensitive to GA application (100 ppm) at the 2-leaf stage which caused some pollen degeneration. Hassan *et al.* [8] found that GA treatments increased grain yield of corn cv. 186. Ashour [9] found that GA slightly increased grain yield of wheat. On the contrary, [10-11] demonstrated that GA

reduced the grain yield of barley plants, while Morgan and Mees [12] reported that spraying winter wheat with GA was not effective on the yield of neither grains or straw.

Calcareous soils represent the reclamation area of the north western coast of Egypt. Since barley is a major cereal crop in such soils for human and animal feed as well as in molt industry, more efforts and studies are necessary to improve its productivity.

This work was carried out to compare the effect of two GA concentrations used as a foliar spray on the growth and yield components of barley plants grown on calcareous soils.

Materials and Methods

Two pot experiments were carried out in a greenhouse during 1982 and 1983. Twenty calcareous soil samples brought from the north western coast of Egypt were air dried, ground and sieved through a 2-mm-sieve. Physiochemical characteristics of these soils were determined by the standard procedures. Mechanical analysis was carried out using the pipette method as described by Wright [13]. The pH was measured in 1:2.5 soil:water suspension while soil organic matter was determined according to Walkely [14]. $CaCO_3$ content was measured volumetrically using Collin's calcimeter (Wright [13]. Phosphorus was determined by the method described by Olsen *ét al.* [15], and the total exchangeable cations were determined according to Piper [16]. Analysis indicated that these soils are alkaline in nature with a pH of about 8, poor in organic matter with a mean of 0.4%. The mean values of other soil properties such as $CaCO_3$, available P, clay content, and CEC were 18.4%, 6.1 ppm, 13.65% and 8.7 meq/100 g soil, respectively.

Planting was done in glazed clay pots 30 cm in diameter. One kg of gravel was put in the bottom of each pot, and five kgs of soil were placed on the top of the gravel. Each treatment was replicated 6 times in a randomized complete block design. The basal dressing of P_2O_5 was applied just before planting at the local recommended rate of 15 kgs/acre as superphosphate (0.5 g/pot). Fifteen seeds of barley cv. 121 were planted in each pot, covered with a thin layer of pure sand and watered to about 60% soil water holding capacity. Seedlings were thinned three weeks after planting to 5 seedlings/pot and the basal treatments at the local rate and kinds of N as $Ca(NO_3)_2$ and K as K_2SO_4 were 2 g/pot and 0.5 g/pot followed the rates of 60 kg N/acre and 24 kg K_2O/acre, respectively.

Gibberellic acid used as foliar spray 40 days after planting was 100 ppm and 50 ppm. Triton B was added as a wetting agent. Plant samples were taken during the booting stage (75 days after planting). Plants were cut 1 cm above the ground, carefully cleaned, cut to small pieces and dried at 75°C in a forced air over for 24 hr and then weighed. Harvested plants were separated to straw and grains and weight determined. The moisture content of grains at harvest was 8%. The weight of 1000 grains was also recorded.

Results and Discussion

Plant height

Only data on the effect of 50 ppm GA on the height of barley plants are presented and discussed, as GA at 100 ppm was considered an extremely high concentration for barley growth and caused lodging.

The data obtained show that the promoting action of GA may have been responsible for the higher gradual shift in the rate of elongation than the control plants. Gibberellic acid at 50 ppm improved plant height during the period of 60-105 days after planting (Table 1). In this respect, the increase in stem length of GA-treated plants was usually reported as due to the increase in the length of internodes [17]. However, Feucht and Watson [18] observed that GA not only promoted the elongation of internodes of treated plants but increased also their number as well.

Table 1. The effect of 50 ppm GA on barley plant height (cm) during the growing season

Treatment	Days after planting						
	45	60	75	90	105	120	130
GA	9.9	17.7	30.8	42.9	65.8	74.3	74.8
Control	9.1	12.3	15.4	26.3	46.1	67.7	69.4
Plant height increase%	9	44	100	63	43	10	8

Data presented in Table 1 show that the maximum effect of GA on plant height was obtained 75 days after planting (35 days after spraying with GA). Thus, it can be concluded that the most suitable time for spraying barley plants grown in calcareous soils with 50 ppm GA is one month after planting. In this connection Brain *et al.* [1] found that GA increased shoot growth of peas and wheat as a result of increasing their stem length. Blesa and Gomez [19] also stated that GA stimulated shoot growth of wheat seedlings but the effect decreased with advancing age.

It is worth mentioning that the effect of soil properties on growth of yield and barley plants was not significant in the two growing seasons. Results obtained here clarify that the GA stimulating action on plants shadowed soil factors effect.

Growth and Yield characters

The number of total tillers 75 days after planting was increased by both GA concentrations (Table 2). In both growing seasons, the mean total numbers of tillers/pot were about 14.9 and 27.2 for 50 and 100 ppm GA treatments, respectively. In this respect Saini *et al.* [4] and Dolonicki [20] reported that spraying wheat plants with GA stimulated plant growth and increased tillers survival.

Table 2. Response of barley plants to 0, 50 and 100 ppm GA spray treatments for 1982 and 1983 seasons

Treat. GA ppm	Tiller No. /pot		Dry wt. g/pot		Ears No. /pot		Straw g/pot		Grain g/pot		1000-grain wt., g	
	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983
0	8.9	9.4	9.9	10.6	16.6	16.7	41.4	42.7	10.6	11.3	42.4	41.4
50	14.6	15.3	18.8	18.7	25.7	25.8	55.2	56.5	19.4	20.5	42.7	42.1
100	26.1	28.4	27.7	27.5	43.2	45.1	77.9	80.6	9.3	10.5	11.4	11.2
LSD.01	6.1	6.7	8.1	8.4	3.4	4.6	14.6	14.4	1.6	1.9	15.1	15.4
LSD.05	4.6	4.3	6.1	6.3	3.1	3.5	11.0	10.8	1.2	1.4	11.3	11.0

Dry matter accumulation responded clearly to both GA treatments (Table 2). More dry weight was produced in the 100 ppm than the 50 ppm GA treatment (27.6 and 18.8 g/pot, respectively). These findings agree with those of Singh and Randhawa [3], Dolonicki [20], Saini *et al.* [4].

The 1000-grain weight was greater in the 500 ppm than in the 100 ppm GA treatment (42.4 and 11.3 g, respectively). On the contrary, Randev *et al.* [11] reported that GA reduced number of grains/ear. Number of total ears/pot increased in both seasons with the increase in GA concentration (44.1 and 25.8 for the 100 ppm and 50 ppm GA, respectively). The lower number of ears/pot at the higher GA concentration was probably due to the presence of abnormally grown ears. Schmalz and Mettin [7] tested several barley varieties and concluded that GA application at high concentration (100 ppm) at the second leaf stage caused some pollen degeneration.

More grain yield was produced at the lower GA concentration than at the higher concentration, and this was true in both seasons (19.9 and 9.9 g, respectively). More straw was, however, produced at the higher GA application in both seasons (79.3 and 55.9 g/pot, respectively).

References

[1] **Brain, B.W., Elson, G.W., Hemming, H.G.** and **Radehy, M.** "The Plant Growth Promting Properties of Gibberellic Acid, a Metaboilic Product of the Fungus *Gibberella fujikuori.*" *J. Sci. Food Agric.* **5** (1954) 602-612.

[2] **Wolf, W.** and **Haber, A.** "Chlorophyll Contents of Gibberellin Treated Wheat Seedlings." *Nature,* London, (1960) 186-217.

[3] **Singh, K.** and **Randhawa, K.S.** "Vegetative Growth Flowering and Fruiting of Battle Ground." *J. Res. Punjab Agr. Univ.* **6,** No. 3 (1969) 798-800.

[4] **Saini, A.D., Sud, A.** and **Nanda, R.** "Growth Regulator in Relation to Tillering in Wheat." *Ind. Plant Physiol.* **18,** No. 2 (1975) 140-160.

[5] **Abdel Latif, E.A.** "Physiological Studies on Growth and Yield of Barley Plant Grown on Calcareous Soil." *Ph.D. Thesis,* Faculty of Agric., Cairo University (1981).

[6] **Singh, H.G.** and **Darra, B.L.** "Influence of Presoaking of Seeds with Gibberellin and Auxin on Growth and Yield Attributes of Wheat under High Salinity, Sodium Absorption and Boron Levels." *Indian J. Agric. Sci.* **4** (1971) 978-1003.

[7] **Schmalz, H.** and **Mettin, D.** "Correlation between Stage of Development and GA Sensitivity in Spring Barley (Ger.)." *Zuchter* **35** (1965) 72-79. (c.f. *Field Crop Abst.* **18,** 4, 1771).

[8] **Hassan, H.M., Kheir, N.F., El-Shafey, Y.** and **Ibrahim, A.A.** "Growth and Yield of Corn Plant as Affected by GA and Micronutrients." *Ann. Agric. Sci.* Moshtohor. Fac. Agric., Helwan Univ., Egypt. **6** (1976) 139-147.

[9] **Ashour, N.I.** "Effect of Foliar Application on Wheat Plants with Micronutrients and Gibberellic Acid on Yield, Nitrogen and Carbohydrate Contents of Grains." *Agrochemica* **15** (1971) 415-339. (c.f. *Field Crop Abst.*, **25,** 3 (1972) 2940.

[10] **Heyland, K.U., Solanky, S.** and **Aufmamer, W.** "Effect of CCC and GA Treatments on the Yield Component of Spring Barley." *Z. Ackerund Pflan.*, **141,** No. 2 (1975) 109-119. (c.f. *Plant Growth Regulator Abst.* **2,** 5, 747).

[11] **Randev, R., Mashev, N.** and **Vasilev, G.** "Influence of Some Micro-Elements and Photohormones on the Photosynthesis Intensity and Yield of Malting Barley." *Rasteniev, dni Nauki Bulgaria.* **12,** No. 7 (1975) 3-9. (c.f. *Soils and Fertilizers,* **39,** 3, 2403).

[12] **Morgan, D.G.** and **Mees, G.C.** "Gibberellic Acid and the Growth of Crop Plants." *J. Agric. Sci.* **50** (1958) 49-58.

[13] **Wright, G.H.** *Soil Analysis.* London: Thomas Marby & Co., 1939.

[14] **Walkely, A.** "A Critical Examination of Rapid Method for Determining Organic Carbon in Soils. Effect of Variations in Digesting Conditions and of Organic Soil Contituents." *Soil Sci.* **63** (1947) 251-269.

[15] **Olsen, S.R., Cole, C.V., Watanabe, F.S.** and **Dean, L.A.** *Estimation of Available Phosphorus in Soils by Extraction with Sodium Carbonate.* U.S.D.A.: Circ. 939, (1954).

[16] **Piper, C.S.** *Soil and Plant Analysis.* N.Y.: Inter. Science Publisher, Inc., 1950.

[17] **Saleh, S.A.** "The Effect of Foliar Application of GA and Some Micronutrients on the Growth and Yield Components of Wheat." *Egypt. J. Agron.* **4,** No. 2 (1979) 221-230.

[18] **Feucht, J.R.** and **Watson, D.P.** "The Effect of Gibberellins on Internodal Tissues of *Phaseolus Vulgaris* L." *Amer. J. Bot.* **45,** No. 47 (1958) 520-522.

[19] **Blesa, A.C.** and **Gomez, A.C.** "A Study of the Action of Gibberellic Acid on Wheat Seedlings." *Indian J. Plant Physiol.* **9** (1966) 114-121. (c.f. *Field Crop Abst.* 1976, **29,** 8 6193).

[20] **Dolonicki, A.** "The Effect of Growth Regulators and their Mixture on Frost Resistance of Wheat." *Acta. Agraria* (c.f. *Field Crop. Abst.* 1976, **29,** No. 8 (1975), 6193).

تأثير المعاملة بحمض الجبرليك على نمو ومحصول الشعير تحت ظروف الأراضي الجيرية

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ملخص البحث . أجريت هذه الدراسة في إصص تحت ظروف الصوبة الزجاجية، وكان الغرض من هذا البحث هو تحديد أنسب ميعاد للرش بحمض الجبرليك وتأثير ذلك على نمو ومحصول الشعير النامي في تربة جيرية .

وقد أوضحت النتائج المتحصل عليها أن أنسب ميعاد لرش النباتات هو بعد ٤٠ يومًا من الزراعة، وقد أدى الرش بتركيز ٥٠ جزء في المليون إلى زيادة في المحصول ومكوناته، بينما أدى الرش بتركيز ١٠٠ جزء من المليون إلى زيادة كبيرة في ارتفاع النباتات وزيادة عدد الأفرع مما أدى إلى رقاد النباتات مع نقص في المحصول.