Original Article

Prestimulation of wheat seedlings with gibberellic acid (10^{-3}, 10^{-4} and 10^{-5} parts by weight) followed by application of an agitated high dilution (10^{-30} parts by weight) of the same hormone

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ABSTRACT

In previous multicentre studies, the influence of a homeopathic ultra-high dilution of gibberellic acid on wheat growth was scrutinized. Data showed that this test dilution slowed down stalk growth when experiments were performed in the autumn season. The aim of this work was to test the hypothesis that pretreatment of grains with high concentrations of gibberellic acid would enhance the growth-inhibiting effect of the ultra-high dilution of the plant hormone. Grains of winter wheat (*Triticum aestivum*, 500 or 1000 per group) were pretreated with (non-agitated) gibberellic acid 10^{-5}, 10^{-4} and 10^{-3} parts by weight (Ge-5, Ge-4, Ge-3) or with water ("W0") for control prior to further treatment. Grains were then observed under the influence of extremely diluted gibberellic acid (10^{-30} parts by weigth) prepared by stepwise dilution and agitation according to a protocol derived from homeopathy ("G30x"). Analogously prepared water was used for control ("W30x"). Seedlings were allowed to develop under standardized conditions for 7 days; plants were harvested and stalk lengths were measured. Of the four pretreatment variants under study, Ge-3 yielded most growth, followed by Ge-4 , Ge-5 and finally W. This outcome was modulated by the application of G30x in that the inhibition obtained with G30x as compared to W30x was the greater the lower the pretreatment concentration of G had been. The hypothesis that pretreatment of grains with high concentrations of gibberellic acid would enhance the growth inhibiting effect of G30x had to be rejected. Rather, G30x slowed down stalk growth most in the W0 group with $p < 0.001$, only moderately in the Ge-5 and Ge-4 group and not at all in the Ge-3 group.

Introduction

The present study was inspired by the resemblance that exists between the "principle of similars" used in homeopathy and detoxication effects known to conventional science. It can be termed an isopathic detoxication study. This is a category of experimental models with which it has been possible over the decades to reveal a diversity of biological phenomena which all highlight this resemblance and which are all brought about by the same basic experimental procedure: An organism is first intoxicated with an agent in molecular concentration, and then an attempt at detoxification or 'cure' is made by applying the same agent in diluted / agitated form [1,2]. The study was further inspired by the concept that organisms going through a crucial phase in their ontogenetic development may be more sensitive to subtle influences than otherwise. One

experimental model that captures both of these two features is that of metamorphosing highland amphibians, in which diluted, agitated thyroxine has been found to slow down metamorphosis [3,4]. Another, located in the botanical realm, and forming the basis of the present study, is a model on the treatment of wheat seedlings with gibberellic acid. Both of these models stand somewhat apart from most other detoxication studies in that the primary effect is not an intoxication brought about by a toxin but a physiological process brought about by a natural hormone, and that the term "detoxication" does likewise not apply in the strict sense.

Our use of an ultra high dilution finds justification in a previous meta study on fundamental research models involving homeopathically prepared dilutions beyond Avogadro's number [5]. In the following, when relating to dilutions beyond 10^{-23}, the authors e.g. use the term "10^{-30}" in reference to a 30fold dilution of 1:10 rather than to an immensurable molarity.

In keeping with the concept described above, the goal was to observe the development of wheat seedlings treated with extremely diluted / agitated solutions of gibberellic acid (10^{-30}, "G30x", "verum"), this being a substance on whose derivatives wheat depends for its normal development. The target parameters were wheat germination rate after one day [6] and wheat stalk length after one week [7,8]. The effects of G30x were compared with those of analogously prepared solvent water) ("W30x") and to untreated water ("W0") as two different controls. Grains of winter wheat (*Triticum aestivum*, Capo variety) were used.

In precursors of the present study, 4 germination experiments were performed in September and 4 in October/November, involving a total of 6 multicentre researchers and 4000 grains per treatment group(G30x or W30x). Data were found to be homogeneous within control groups as well as within verum groups. When the results of the September experiments were pooled, mean germination rates after one day were (85.9 ± 2.6)% for the control group and (82.1 ± 5.7)% for G30x (mean ± standard deviation) (N = 2,000 per group). Verum germination rate was 3.4% *smaller* than (i.e. equal to 96.6% of) control germination rate (100%). The difference was statistically significant ($p < 0.001$) and the effect size, defined as the mean difference between groups, divided by the standard deviation) was large ($d > 0.8$). In contrast, when the experiments performed in October/November were pooled (N = 2,000 per group) there was practically no difference between groups ($p > 0.05$). Seasonal variance (i.e. a difference in seedling sensitivity towards G30x between September and October/November in the one-day germination experiment) was discussed as a possible reason for this discrepancy in results [6].

In the precursor studies on stalk length, 9 experiments were performed in autumn involving 5 multicentre researchers and about 4,500 grains per group according to treatment and 6 in winter/spring, (4 researchers, about 3,000 grains per group). Data were found to be homogeneous within the control groups as well as within the verum groups. When the results of the autumn experiments were pooled, mean stalk lengths after one week were (47.0±3.9) mm for the verum group and (50.7±3.4) mm for control at dish level (20 grains per dish, N = 4,440 per treatment group). Verum stalk length was 7.3% *smaller* than control stalk length (100%) (Figure 1). The difference was statistically significant ($p < 0.001$) and the effect size (d) was large (> 0.8).

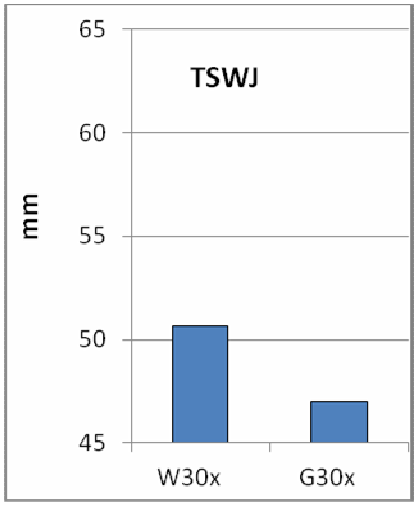

Figure 1: Stalk length of W30x and G30x groups in mm (ordinate). Pooled data from the multicentre experiments published in The Scientific World Journal (TSWJ) [8]. For further explanations see text.

In contrast, when the experiments performed in winter/spring were pooled (N = 3,000 per treatment group) there was practically no difference between the groups ($p > 0.05$). Seasonal variance was again discussed as a potential determining factor [8].

The aim of the study presented here was

- to have the effect of G30x on wheat stalk length reinvestigated by an independent researcher (SH, see list of authors), and
- to investigate the effect of G30x after prestimulation of wheat seedlings by molecular doses of gibberellic acid (10^{-5}, 10^{-4} and 10^{-3} parts by weight).

Our hypothesis was

- that G30x would exert an inhibiting effect on stalk growth (this hypothesis follows from the authors' previous studies [7,8]) and that
- this inhibiting effect would become the stronger the higher the dosage of prestimulating gibberellic acid. This hypothesis was derived from the idea that organisms intoxicated with a substance could be detoxicated by the same substance in "homeopathic" preparation [1].

Methods

Experiments were documented in accordance with the recommendations of the K. and V. Carstens Foundation, Essen for good fundamental research documentation in homeopathy [9].

Plants

Experiments were performed on wheat (*Triticum aestivum*, Capo variety, procured from Fritz organic farming, Ottendorf, Styria, Austria) grain grown without herbicides or pesticides (harvest 2011). Around 10% of the grains were ruptured and around 10% were distorted, and these were all removed prior to the experiments.

Researchers, sites and dates

Experiments were performed by SH (study 1, October 16th-22nd, 2011) and WS (study 2, November 2nd-8th, 2011) (see table 2) at the laboratory of the Interuniversity College in Weiz near Graz. The project was coordinated by HG and supervised by CE (for initials, see list of authors).

Laboratory conditions

All glass bottles and fastenings as well as the plastic pipettes used for the dilution process were disposable products. All dishes and covering glass vessels as well as the glass pipettes used for administration of the probes were heat sterilized and rinsed twice with double distilled water prior to use. Seedling development took place in complete darkness at a temperature of (21.5 ± 0.2)°C (study 1) or (20.0 ± 0.2)°C (study 2).

Preparation of solutions

Treatment substances

Grains were observed under the influence of extremely diluted agitated gibberellic acid with analogously prepared water serving as control. The treatment substance was prepared by stepwise dilution and succussion using a method derived from homeopathy and inspired in detail by Baumgartner [10, 11]. The degree of dilution was set to 10^{-30} so as to exceed Avogadro's limit of theoretical zero-molarity (10^{-24}). Gibberellic acid was chosen as the active agent on account of the crucial role of its derivatives in normal plant development. This rationale had proven fruitful in earlier analogous experiments on the influence of homeopathically prepared thyroxine in amphibians [3, 4].

For preparation of the treatment substance, 0.017 g of gibberellic acid (Sigma-Aldrich company, art. no. 36575) were added to 9 ml of acetone, and the resulting 5 millimolar solution (substance "1") was gently swung (not "agitated") in a xy ml glass bottle (?) for one minute (= "mother substance"). Then, using a disposable pipette (Brand company, Transferpette 100µ), 1 ml of the mother substance was added to 9 ml of double distilled water in a 20 ml brown glass bottle (Heiland company, art. no. 380020), and the product was agitated vigorously according to a standardized protocol: The bottle was manually banged 30 times against an elastic surface at intervals of approximately 0.5s to create mechanical shocks (= "G2x"). In a total of 30 steps of dilution 1:10 and 29 steps of agitation (as agitation was omitted at the first dilution step), the test substance "G30x" was thus prepared. Starting from the 28th step, quantities larger than 1ml were added to the tenfold amount of double distilled water in order to prepare a sufficient quantity of test substance. Larger brown glass bottles (each of which was filled half with the liquid) were used for these last steps (29x: 250 ml, 30x: 500 ml). A new glass bottle was used for each dilution step.

Analogously prepared solvent (i.e. in step 1x acetone, then water in steps 2x to 30x) was used for control ("W30x") to ensure that any solute contents of the glass wall would be equally present both in verum 30x and control 30x and the content of solute oxygen would also be alike. Thus, any difference in growth observed between verum- and control-treated seedlings would be attributable to the presence or absence of gibberellic acid in the mother substance.

In some experiments untreated water (=W0) served as an additional control (see Table 1 and 2, first row: treatment)results obtained from these seedlings were pooled with /analysed separately from those from W30x-treated seedlings.

Pretreatment substances

As can be seen in Table 1, second row, grains were pretreated with inert water control (for blinding purposes) or with gibberellic acid 10^{-5} parts by weight (molarity $5x10^{-8}$), 10^{-4} ($5x10^{-7}$) or 10^{-3} ($5x10^{-6}$) respectively.

Treatment	W0	W30x	G30x	W30x	G30x	W0	W30x	G30x	W30x	G30x
Pretreatment	W0	W0	W0	Ge-5	Ge-5	Ge-4	Ge-4	Ge-4	Ge-3	Ge-3

Table 1: Substances used for pre treatment and treatment. For explanations, see text.

All test substances (for treatment and pretreatment) were prepared by WS. Substances were prepared separately for studies 1 and 2 and were applied one day after preparation in both cases.

System performance controls

Previous experiments had shown that differential treatment with W30x or with water that has not undergone any preparation process at all (W0, negative control) produces no differences in stalk length measured after one week (W30x: 50 ± 22 mm; W0: 50 ± 21 mm). The number of grains per group in these earlier experiments was 2,000, and temperature was (21.5 ± 1.0)°C.

Previous experiments using a positive system control had shown that after one week stalk lengths are greater under treatment with gibberellic acid at molecular doses (10^{-4} parts by weight: 54 ± 22 mm; 10^{-6}: 47 ± 23 mm) than after exposure to water control (45 ± 23 mm) (number of grains per group = 200, temperature 20 ± 1°C). These differences are, however, not statistically significant ($p > 0.05$). No experiments have as yet been performed on gibberellic acid 10^{-3} or 10^{-5}.

Previous analysis of wheat growth under treatment with inert water control with the same spatial arrangement of dishes and plants as in the present study had shown a high degree of statistical homogeneity within dishes. Homogeneity was also investigated in the present study.

Independent probe coding

Control and verum were encoded by an independent authority. All probes were applied blindly; codes were broken only after the data had been calculated.

Data base

As is shown in Table 2), 6 treatment groups of 500 grains were observed in study 1, and 6 in study 2. There were 20 grains per dish, i.e. 25 or 50 dishes per treatment group.

Treatment		W0	W30x	G30x	W30x	G30x	W0	W30x	G30x	W30x	G30x
Pretreatment		W0	W0	W0	Ge-5	Ge-5	Ge-4	Ge-4	Ge-4	Ge-3	Ge-3
Study 1	N	500	500	500			500	500	500		
Study 2	N				500	500		500	500	500	500

Table 2: Pretreatment and treatment regimen by individual treatment group in studies 1 and 2. For further explanations, see text.

Placement of grains

Grains were arranged circularly in glass dishes (diameter 11 cm), each containing 1 layer of filter paper (Whatman, cellulose, 90 mm, sort 2), with the germination furrow facing down (Figure 2).

Figure 2: Placement of grains (from [8]).

Exposure to probes

For *pretreatment,* 2 ml of W0, Ge-5, Ge-4 or Ge-3, respectively, were added to each dish using a disposable 5 ml pipette and pipetting ball (VWR company, art. no. 612-1328 and 612-1947), and grains were left to soak for 4 hours. For *treatment,* 3 ml of G30x, W30x or W0 were added to the dishes, respectively. Dishes were then covered with 1000 ml glass vessels (up-side down beakers) and dishes and covers were wrapped in aluminium foil (Figure 3).

Figure 3: Seedling cultivation in beakers (from [8]).

Beakers were placed in alternating rows according to a random procedure (stratified randomization).

Observed development (endpoints)

Both in studies 1 and 2, germination and stalk length (Figure 4) were observed after 7 days according to a standard protocol [8]. Stalks were cut off by one person and measured by naked eye on a mm scale by another person. The person performing the measurements knew neither how stalks had been treated (see blinding procedure above) nor what their blind code was. Any possibility of an assignment bias was thus ruled out. Results were recorded by a third person. Dishes were harvested in the same sequence as they had been prepared.

Figure 4: Stalk growth. From [7].

Data evaluation

Differences in germination rate were evaluated at the end of theexperiment, i.e. after seven days, by entering the number of germinated and non-germinated seedlings of each treatment group and its corresponding control group in four-field tables according to the chi square test.

Stalk length was determined in terms of the arithmetic mean per dish and its S.D. and evaluated by one way analysis of variance. P-values were corrected for multiple testing. Effect sizes (Cohen's d, standardized difference of means = absolute difference between means of 2 groups, divided by S.D.) were also calculated. An effect size is considered small when > 0.2, medium when > 0.5 and large when > 0.8.

Data were evaluated blindly, i.e. the statistician (HL) was not aware of the meaning of the codes used. Codes were broken only after calculation of results.

The results for the Ge-4/W30x groups were normalized to 100% in the graphic representation, this being the only treatment combination that was used in both studies.

Results

As can be seen in Table 3, germination rates after 7 days were practically alike in all groups ($p > 0.05$).

Treatment		W	W30x	G30x	W30x	G30x	W	W30x	G30x	W30x	G30x
Pretreatment		W	W	W	Ge-5	Ge-5	Ge-4	Ge-4	Ge-4	Ge-3	Ge-3
Study 1	N	492	490	494			484	489	489		

	%	*98.4*	*98*	*98.8*			*96.8*	*97.8*	*97.8*		
Study 2	N				486	483		488	488	488	482
	%				*97.2*	*96.6*		*97.6*	*97.6*	*97.6*	*96.4*

Table. 3: Germinated seedlings per group, numbers and percentages (500 = 100%). For explanations, see Table 2 and text.

Tables 4-5 and Figures 5-7 give an overview of the results on stalk growth.

Figure 5 shows the combined results of studies 1 and 2 in terms of relative stalk length. Grain numbers were initially 1,000 each for Ge-4/W30x and Ge-4/G30x, and 500 for each of the other treatment groups, but only germinated grains were included in the results.

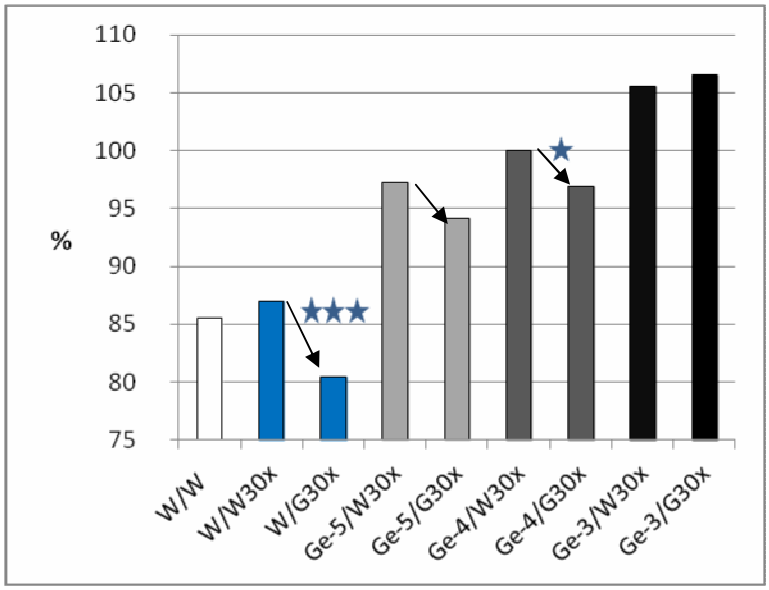

Figure 5: Results from studies 1 and 2 showing relative stalk length by treatment group with Ge-4/W30x normalized to 100%. N per group = 500, except for Ge-4/W30x (N = 1000) and Ge-4/G30x (N = 1000). ***, $p < 0.001$; *, $p < 0.01$. P-values refer to pairwise comparison of W30x versus G30x groups. For further p-values, see Table 5. Only germinated grains were considered. For further explanations see text.

Of the four pretreatment variants under study, Ge-3 yielded most growth, followed by Ge-4 , Ge-5 and finally W. This outcome was modulated by the application of G30x in that the inhibition obtained with G30x as compared to W30x was the greater the lower the pretreatment concentration of G had been (Figure 1).

Table 4 shows the stalk length data of studies 1 and 2 both separately and pooled.

Treatment		W	W30x	G30x	W30x	G30x	W	W30x	G30x	W30x	G30x
Pretreatment		W	W	W	Ge-5	Ge-5	Ge-4	Ge-4	Ge-4	Ge-3	Ge-3
	mean±SD										

Study 1	all	63.1±7.3	63.9±6.3	59.5±8.0			74±13	73±11	69.2±9.9		
	%	*86.1*	*87.2*	*81.3*			*101.6*	*100*	*94.4*		
	germ	64.1±7.2	65.2±7.1	60.3±8.0			77±12	74.9±9.9	70.7±9.7		
	%	*85.5*	*87*	*80.5*			*102.7*	*100*	*94.4*		
Study 2	all				56.1±5.4	54±4.7		57.9±3.8	57.6±7.0	61.1±5.7	61.0±5.8
	%				*96.9*	*93.2*		*100*	*99.5*	*105.5*	*105.2*
	germ				57.8±5.4	55.9±4.8		59.3±4.4	59±7.2	62.6±5.5	63.2±5.7
	%				*97.3*	*94.1*		*100*	*99.5*	*105.5*	*106.5*
Study 1+2	all							66.4	64.2		
	%							*100*	*97*		
	germ							66.3	64.1		
	%							*100*	*97*		

Table 4: Absolute stalk length (mean±S.D. at dish level; mm) by treatment group shown first separately for studies 1 and 2 (first two blocks) and then pooled (third block). The upper two lines of each block give the results for all treated grains ("all", i.e. non-germinated grains were assigned the value 0 mm) and the lower two only those for grains that had germinated during the 7-day experiment ("germ"). Percentages refer to the Ge-4/W30x group. For further explanations, see text.

Mean stalk length in the W0/G30x group was 60.3±8.0 mm, i.e. 7.5% smaller than (or 92.5% as great as) it was in the W0/W30x group (65.2±7.1 mm) and 5.9% smaller than it was in the W0/W0 group (64.1±7.2). Both differences are statistically significant ($p < 0.001$ and $p < 0.01$ respectively) and both are associated with a medium effect size ($d = 0.64$ and $d = 0.5$ respectively). In the Ge-5/G30x group mean stalk length was (55.9±4.8 mm), i.e. 3.4% smaller than (or 96.7% as great as) it was in the Ge-5/W30x group (57.8±5.4 mm). This difference is not statistically significant ($p > 0.05$). In the Ge-4/G30x group mean stalk length was 64.1 mm, i.e. 3.0% smaller than it was in the Ge-4/W30x group (66.3mm). In the Ge-4/G30x group mean stalk length was 70.7±9.7 mm, i.e. 8.1% smaller than it was in the Ge-4/W group (77±12 mm). Both differences are statistically significant ($p < 0.05$ and $p < 0.001$ respectively), the effect sizes were medium (0.57), respectively.

In the Ge-3/G30x group mean stalk length was (63.2±5.7), i.e. 1% greater than it was in the Ge-3/W30x group (62.6±5.5) ($p > 0.05$).

Further information on p-values is provided in Table 5. This background table gives the significance levels of differences between selected pairs of treatment groups. The first two table sections consider studies 1 and 2 separately and while the last section considers the pooled data (germinated grains only).

Treatment		W	W	W	Ge-5	Ge-5	Ge-4	Ge-4	Ge-4	Ge-3	Ge-3
Pretreatment		W	W30x	G30x	W30x	G30x	W	W30x	G30x	W30x	G30x
Study 1											
W	W		>0.05	<0.01							

W	W30x	>0.05		<0.001							
W	G30x	<0.01	<0.001								
Ge-5	W30x										
Ge-5	G30x										
Ge-4	W							>0.05	<0.001		
Ge-4	W30x						>0.05		<0.001		
Ge-4	G30x						<0.001	<0.001			
Ge-3	W30x										
Ge-3	G30x										
Study 2		W	W	W	Ge-5	Ge-5	Ge-4	Ge-4	Ge-4	Ge-3	Ge-3
		W	W30x	G30x	W30x	G30x	W	W30x	G30x	W30x	G30x
W	W										
W	W30x										
W	G30x										
Ge-5	W30x					>0.05		<0.05	<0.05	<0.001	<0.001
Ge-5	G30x				>0.05			<0.05	<0.05	<0.001	<0.001
Ge-4	W										
Ge-4	W30x				<0.05	<0.05			>0.05	<0.001	<0.001
Ge-4	G30x				<0.05	<0.05		>0.05		<0.001	<0.001
Ge-3	W30x				<0.001	<0.001		<0.001	<0.001		
Ge-3	G30x				<0.001	<0.001		<0.001	<0.001		
Studies		W	W	W	Ge-5	Ge-5	Ge-4	Ge-4	Ge-4	Ge-3	Ge-3
1+2		W	W30x	G30x	W30x	G30x	W	W30x	G30x	W30x	G30x
W	W		>0.05	<0.01							
W	W30x	>0.05		<0.001							
W	G30x	<0.01	<0.001								
Ge-5	W30x					>0.05		<0.05	<0.05	<0.001	<0.001
Ge-5	G30x				>0.05			<0.05	<0.05	<0.001	<0.001
Ge-4	W							>0.05	<0.001		
Ge-4	W30x				<0.05	<0.05	>0.05		<0.05	<0.001	<0.001
Ge-4	G30x				<0.05	<0.05	<0.001	<0.05		<0.001	<0.001
Ge-3	W30x				<0.001	<0.001		<0.001	<0.001		
Ge-3	G30x				<0.001	<0.001		<0.001	<0.001		

Table 5 (background table): P-values of differences between treatment groups. Blue figures: values from study 1; green: from study 2; red: from study 1+2 pooled. For explanations, see Table 4 and text.

Figure 6 (background figure) shows the results (in mm) obtained in the studies 1 and 2 separately.

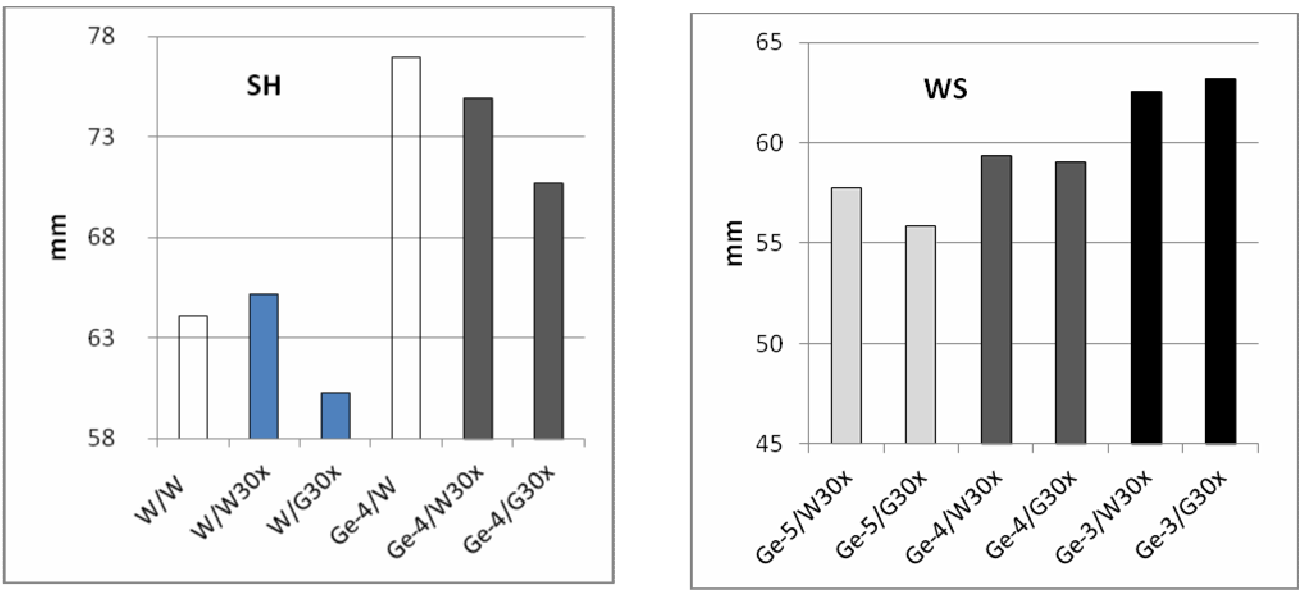

Figure. 6 (background figure): Stalk length in mm by treatment group. Left: results of study 1, performed by SH; right: study 2, performed by WS (see list of authors). For further explanations see Figure 5 and text.

Figure 7 (background figure) gives the results of studies 1 and 2 in terms of relative stalk length for each group of 500 seedlings, i.e. identical treatment groups from different studies are shown separately (germinated grains only). The pooled results of identical treatment groups are shown in Figure 5.

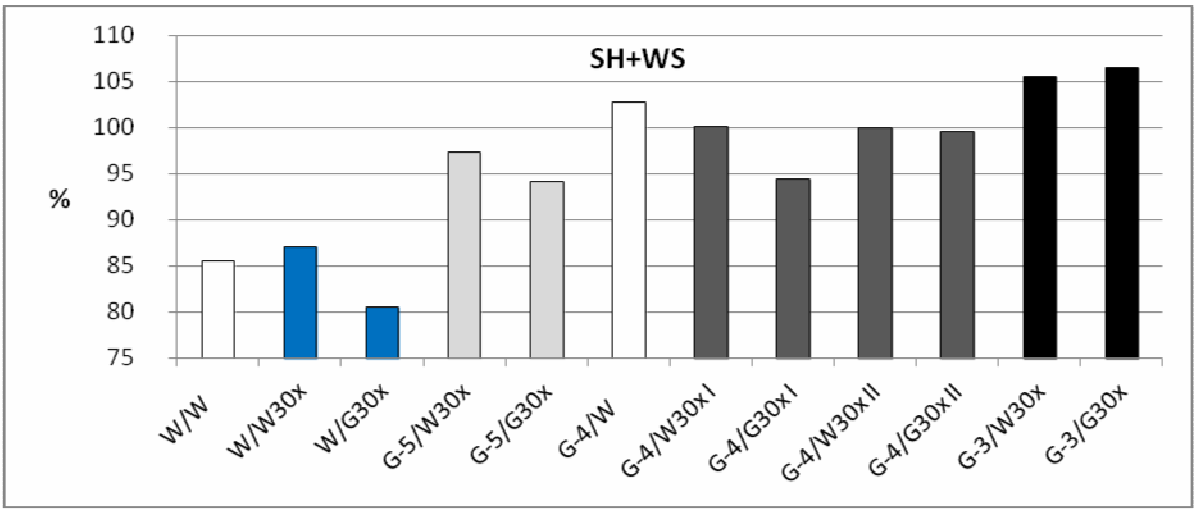

Figure 7 (background figure): Relative stalk length by treatment group of 500 seedlings with Ge-4/W30x normalized to 100% For further explanations see Figure 5 and text.

Discussion

Our hypothesis, based on experiences from analogous isopathic detoxication studies [1,2], was that pretreatment of wheat grains with molecular doses of gibberellic acid would enhance the effect of a homeopathic ultra-high dilution of the same botanical hormone (G30x) on stalk growth. This hypothesis had to be rejected. On the contrary, whereas in the W0 groups G30x slowed down stalk growth (W group) by -7.5% compared to control (W30x) ($p < 0.001$, 500 + 500 grains), its effect in the Ge-5 groups (-3.5%, $p > 0.05$, 500 + 500 grains) and in the Ge-4 groups (-3.0%, 1000 + 1000 grains, $p < 0.05$) was, if anything, smaller, and in the Ge-3 groups there was no such effect at all (+1%, $p > 0.05$, 500 + 500 grains). Thus, the lower the

pretreatment concentration of gibberellic acid, the more marked the slowing-down effect of G30x versus W30x appears to be.

This is in line with experiments on metamorphosis of highland amphibians *(Rana temporaria)* with a homeopathically prepared high dilution of the zoological hormone thyroxine (10^{-30}, "T30x") [3,4]. T30x slows down metamorphosis in inert highland amphibians when compared to W30x (Figure 8, left). This was confirmed by 5 mutually independent researchers with error probability values between $p < 0.05$ and < 0.01. When highland animals were pretreated with a molecular dose of thyroxine (10^{-13} parts by weight of thyroxine in the basin water) in order to initially speed up metamorphosis, T30x was again found to slow down metamorphosis (Figure 8, left). 3 out of 4 mutually independent researchers found a trend towards this effect ($p > 0.05$) [3]. However, pretreatment (hyperstimulation) with molecular thyroxine 10^{-13} *did not enhance the inhibitory* effect of thyroxine 30x; rather the effect was smaller than when no pretreatment was applied.

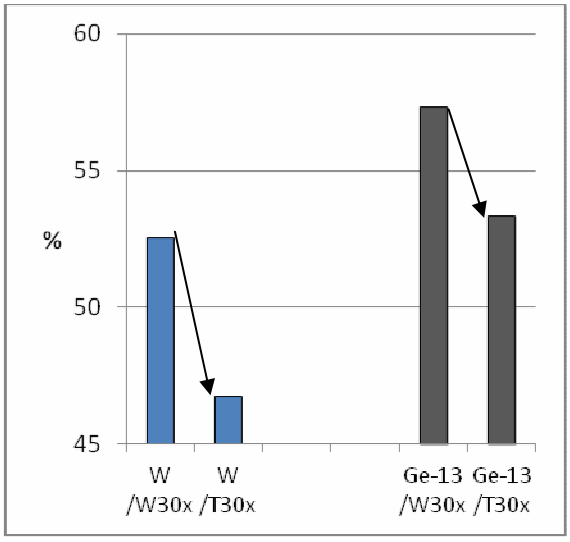

Figure 8: Rate of amphibian metamorphosis (%) in 4 different treatment groups(W/W30x, W/T30x, Ge-13/W30x, Ge-13/T30x). N per W group = 1,650; N per Ge-13 group = 1,000. For further explanations see text.

Although both the amphibian and the wheat model were inspired by effects observed in intoxication / detoxification (or more precise: isopathic detoxication) experiments, and although pretreatment by hyperstimulation with either of the two hormones at a molecular dose level enhanced biological development (metamorphosis and stalk growth, respectively), the results obtained in these two studies are suggestive neither of an intoxication / detoxication mechanism, nor of an "inversion effect" of the homeopathic dilution with regard to the effect of the mother substance.

An interesting way to carry these investigations further might be to pretreat wheat seedlings with gibberellin antagonists prior to treatment with extremely diluted agitated gibberellic acid or to expose them to growth inhibiting factors.

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