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(54) Titre : INVENTION DE STIMULATION DE LA CROISSANCE ET DE LA GERMINATION DES PLANTES

(54) Title: AN INVENTION TO ENHANCE PLANT GROWTH AND GERMINATION



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An Invention to Enhance Plant Growth and Germination

The inventors propose that the growth and germination of some species of plants may be enhanced by exposure to a static magnetic field. The presence of iron containing substances in the cellular tissues of plants and by sensitivity to other aspects of the physical environment such as gravity and light may encourage this activity.

Sensitivity to magnetic fields may carry adaptive value in that the plant may be more able to orient to the cardinal directions, thereby accessing solar radiation more effectively. This may be particularly important when, as a seedling, plants may grow or germinate in shaded areas where exposure to sunlight is only indirect. Where south is would be advantageous in guiding growth in directions most likely to lead to optimal sun exposure as the plant achieves greater height

We have tested the hypothesis that plant growth and germination maybe enhanced through exposure to magnetic fields by planting seeds of the bush bean plant in close proximity to a bank of 98 small round permanent magnets attached to a vertical Styrofoam wall against which pots containing the planted seeds (bush beans) were placed. A second group of bush bean seeds were planted in identical pots placed against a control wall of equivalent reflectance.

One half of the plants were watered with water containing iron filings which were allowed to rust thereby adding greatly to the iron content of the water. The other group were watered with ordinary tap water. This experiment was repeated on a second occasion using the same methodology.

The plants were measured daily and the presence of germination shoots noted. Our data and the appropriate statistical analyses are summarized in the two table attached.

It is apparent that the plants growing in the proximity of the magnetic field show enhanced germination and accelerated growth. The results are statistically significant for plant growth. The germination data show enhancement with exposure to the magnetic field but this is not significant, possibly due to a smaller number of plants studied (we did not examine germination during the first experiment until day 7. The addition of iron saturated water did not have a major effect on growth.

The data suggest that plant growth may be accelerated and germination enhanced by exposure to static magnetic fields. Using much more powerful magnetic fields may further enhance this effect. The commercial applications are obvious as permanent magnets are inexpensive and would compare favorably in cost with the use of other plant enhancers such as fertilizers. Elaborations of our simple design e.g. the movement of plant seedlings on a conveyor belt between rows of permanent or electromagnets could be applied in green house operations etc.

ANOVA Table for height

Inclusion criteria: row=first from Copy of Dataset Plant Science.svd

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
magnet	1	5615.010	5615.010	4.013	.0543	4.013	.479
Subject(Group)	30	41977.471	1399.249				
Category for height	6	42168.257	7028.043	157.948	<.0001	947.688	1.000
Category for height * magnet	6	164.123	27.354	.615	.7183	3.688	.238
Category for height * Subject(Group)	180	8009.263	44.496				

Means Table for height

Effect: Category for height * magnet

Inclusion criteria: row=first from Copy of Dataset Plant Science.svd

	Count	Mean	Std. Dev.	Std. Err.
Magnet, height 7	16	12.438	11.237	2.809
Magnet, Height 8	16	19.625	14.371	3.593
Magnet, Height 9	16	28.313	18.191	4.548
Magnet, Height 10	16	36.313	17.809	4.452
Magnet, Height 11	16	43.188	16.233	4.058
Magnet, Height 12	16	48.875	15.069	3.765
Magnet, Height 13	16	55.188	11.496	2.874
No Magnet, height 7	16	5.750	6.979	1.745
No Magnet, Height 8	16	11.406	10.785	2.696
No Magnet, Height 9	16	18.000	14.109	3.527
No Magnet, Height 10	16	24.750	15.898	4.224
No Magnet, Height 11	16	31.750	18.538	4.635
No Magnet, Height 12	16	38.000	18.740	4.685
No Magnet, Height 13	16	44.188	19.614	4.903

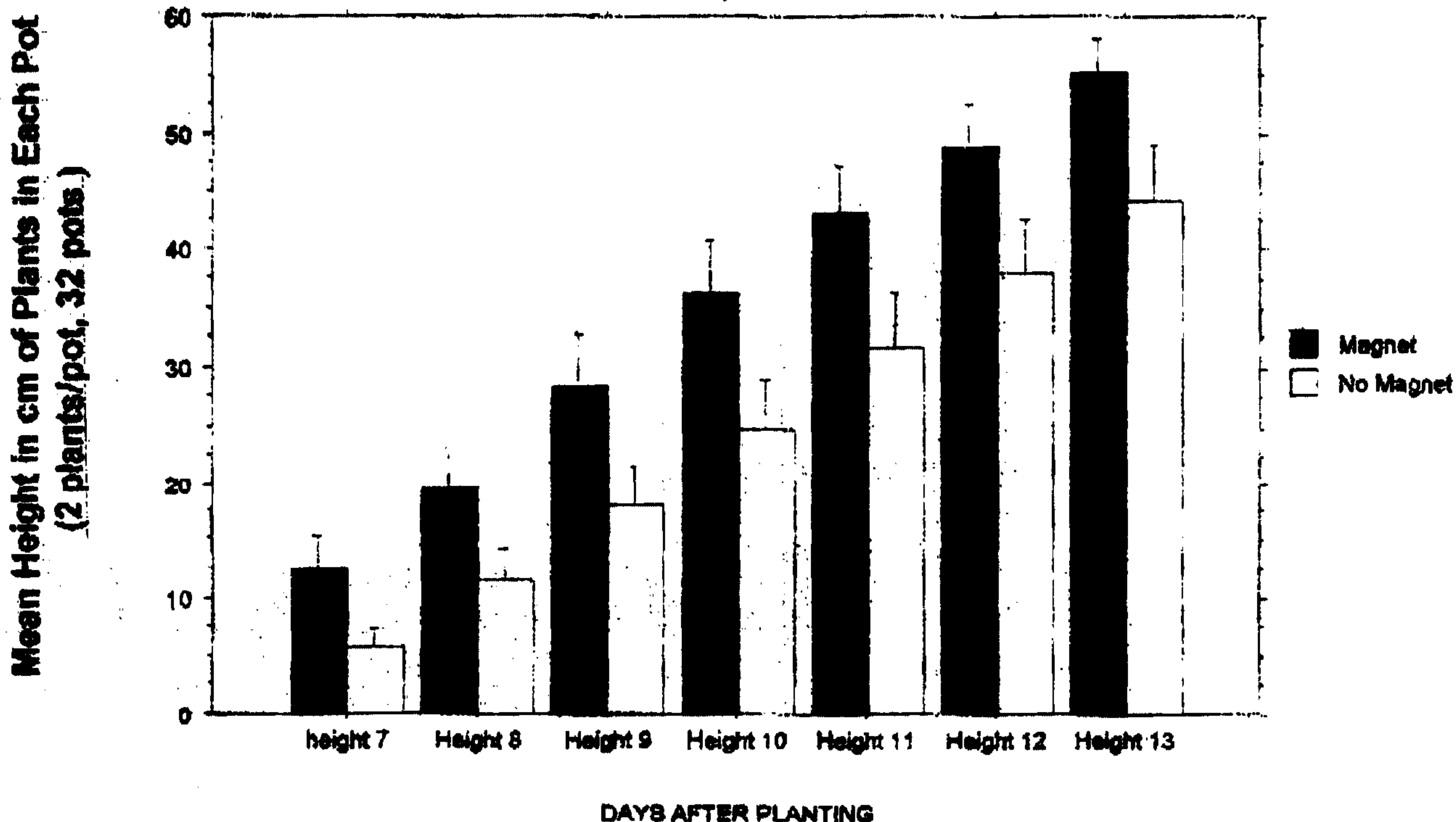
These are the combined data generated by 2 separate experiments. Each experiment was conducted using 8 pots placed beside either a well equipped with 98 permanent round magnets and covered with white paper or a well of equally reflective material that did not contain any magnets. The single light source was a full spectrum incandescent lamp suspended midway between both sets of pots.

Interaction Bar Plot for height

Effect: Category for height * magnet

Error Bars: ± 1 Standard Error(s)

Inclusion criteria: row=first from Copy of Dataset Plant Science.svd



ANOVA Table for Germination 3-7

Inclusion criteria: row eq 1st ANDS exper eq 2 from Rep Measures Dataset Plant Science.svd

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
magnet	1	2.112	2.112	2.333	.1489	2.333	.283
Subject(Group)	14	12.675	.905				
Category for Germination 3-7	4	27.925	6.981	30.787	<.0001	133.134	1.000
Category for Germination 3-7 * magnet	4	.575	.144	.634	.6404	2.535	.182
Category for Germination 3-7 * Subject(Gr...	56	12.700	.227				

Means Table for Germination 3-7

Effect: Category for Germination 3-7 * magnet

Inclusion criteria: row eq 1st ANDS exper eq 2 from Rep Measures Dataset Plant Science.svd

	Count	Mean	Std. Dev.	Std. Err.
Magnet, Germ 3	8	.250	.463	.164
Magnet, Germ4	8	.875	.835	.295
Magnet, Germ5	8	1.500	.535	.189
Magnet, Germ6	8	1.750	.483	.164
Magnet, Germ7	8	2.000	0.000	0.000
No Magnet, Germ 3	8	.125	.354	.125
No Magnet, Germ4	8	.625	.744	.263
No Magnet, Germ5	8	.875	.835	.295
No Magnet, Germ6	8	1.500	.756	.267
No Magnet, Germ7	8	1.625	.518	.183

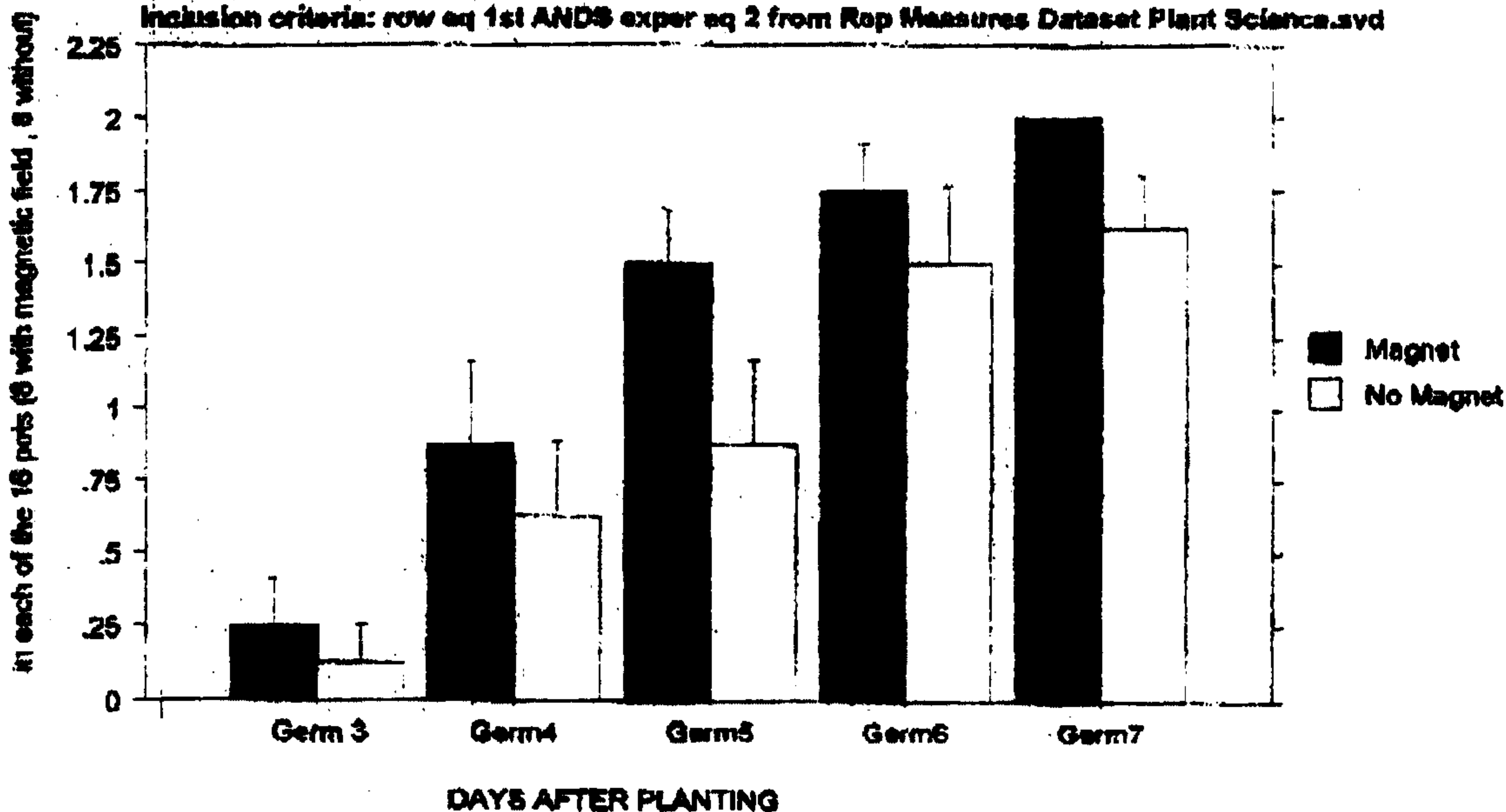
This experiment was conducted in 16 pots with 2 bean seeds placed in each pot. Of the 16 pots 8 were exposed to a static magnetic field and 8 were not.

Interaction Bar Plot for Germination 3-7

Effect: Category for Germination 3-7 * magnet

Error Bars: ± 1 Standard Error(s)

Inclusion criteria: row eq 1st ANDS exper eq 2 from Rep Measures Dataset Plant Science.svd



ANOVA Table for height

Inclusion criteria: row=first from Copy of Dataset Plant Science.svd

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Experiment #	1	7988.189	7988.189	6.994	.0133	6.994	.729
magnet	1	5615.010	5615.010	4.917	.0348	4.917	.565
Experiment # * magnet	1	2019.001	2019.001	1.768	.1843	1.768	.237
Subject(Group)	28	31972.281	1141.867				
Category for height	8	42168.257	7028.043	163.818	<.0001	982.911	1.000
Category for height * Experiment #	8	453.194	75.532	1.761	.1101	10.564	.649
Category for height * magnet	8	164.123	27.354	.638	.7000	3.828	.246
Category for height * Experiment # * magnet	8	348.632	58.105	1.354	.2359	8.128	.514
Category for height * Subject(Group)	168	7207.437	42.901				

Means Table for height

Effect: Category for height * Experiment # * magnet

Inclusion criteria: row=first from Copy of Dataset Plant Science.svd

	Count	Mean	Std. Dev.	Std. Err.
First, Magnet, height 7	8	20.625	10.433	3.688
First, Magnet, Height 8	8	30.750	12.233	4.325
First, Magnet, Height 9	8	38.750	13.499	4.773
First, Magnet, Height 10	8	48.375	14.030	4.980
First, Magnet, Height 11	8	52.625	13.887	4.910
First, Magnet, Height 12	8	57.000	12.750	4.508
First, Magnet, Height 13	8	58.625	14.152	5.003
First, No Magnet, height 7	8	8.125	9.137	3.230
First, No Magnet, Height 8	8	14.250	12.870	4.550
First, No Magnet, Height 9	8	21.250	16.285	5.404
First, No Magnet, Height 10	8	28.500	17.726	6.268
First, No Magnet, Height 11	8	34.125	18.164	6.418
First, No Magnet, Height 12	8	41.375	21.340	7.545
First, No Magnet, Height 13	8	47.000	22.653	8.009
Second, Magnet, height 7	8	4.250	2.815	1.031
Second, Magnet, Height 8	8	6.500	3.182	1.118
Second, Magnet, Height 9	8	17.875	16.669	5.893
Second, Magnet, Height 10	8	24.250	12.266	4.333
Second, Magnet, Height 11	8	33.750	12.970	4.585
Second, Magnet, Height 12	8	40.750	13.134	4.644
Second, Magnet, Height 13	8	51.750	7.479	2.644
Second, No Magnet, height 7	8	3.375	2.825	.999
Second, No Magnet, Height 8	8	8.563	8.069	2.853
Second, No Magnet, Height 9	8	14.750	12.992	4.593
Second, No Magnet, Height 10	8	21.000	18.282	5.760
Second, No Magnet, Height 11	8	29.375	19.849	7.018
Second, No Magnet, Height 12	8	34.625	16.456	5.822
Second, No Magnet, Height 13	8	41.375	17.121	6.053

Results of two experiments with data broken down by experiment 1 and experiment 2

Interaction Bar Plot for height
Effect: Category for height * Experiment # * magnet
Error Bars: ± 1 Standard Error(s)
Inclusion criteria: row=first from Copy of Dataset Plant Science.svd

