

POT EXPERIMENTS TO DETERMINE THE LIMITS OF
ENDURANCE OF DIFFERENT FARM-CROPS FOR
CERTAIN INJURIOUS SUBSTANCES.

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[Read before the Royal Society of N. S. Wales, September 2, 1903.]

Part II.—MAIZE.

THE experiments here recorded are in continuation of similar ones with wheat¹ and were conducted in precisely the same manner. A description of the pots used and the manner in which they were filled and treated is fully given in the previous paper, and need not be here repeated. Mr. Maiden kindly set apart a space in the Botanic Gardens for the purpose of the experiments which were conducted in all details in the same manner as the preceding ones.

Nature of Soil.—The soil with which the pots were filled was a fairly rich garden loam mixed with nearly an equal quantity of a light sand.

The composition of the mixed soil was as follows:—

Moisture	...	...	1·13	per cent.
Organic matter	...	...	8·14	„
Nitrogen	...	...	·202	„
<i>Soluble in strong HCl.</i>				
Lime	...	...	·257	„
Potash...	...	...	·112	„
Magnesia	...	...	·069	„
Phosphoric acid	...	...	·107	„

Each pot received in addition 10 grms of superphosphate. Several check-pots were filled in exactly the same way with the exception that the deleterious substances were omitted.

¹ This Journ. xxxvi., p. 191.

All the pots were exposed to exactly the same conditions as to light, warmth, water, etc., throughout the course of the experiments.

Experiments with Common Salt.

Eight pots were filled with the soil and superphosphate together with the following quantities of common salt per 100 lbs. of soil:—

No. 41,	·10	per cent. of NaCl.	
„ 42,	·15	„	„
„ 43,	·20	„	„
„ 44,	·25	„	„
„ 45,	·30	„	„
„ 46,	·35	„	„
„ 47,	·40	„	„
„ 48,	·50	„	„

The pots were sown on October 24th, 1902, with 7 maize kernels in each pot, the surface being covered with a mulch of shredded cocoa-nut fibre and the soil kept moist throughout the experiment.

The following notes were made on November 3rd with regard to the germination:—

Pots 41 and 42 had germinated well.

In 43, 44, 45, the germination was retarded.

In 46 much, and 47 very much retarded, whilst in 48 the seeds did not germinate.

On November 21st the further growth of the plants was noted:—

In Nos. 41 and 42 the growth was fair, but quite markedly affected.

In No. 43 the growth was very strongly affected.

In Nos. 44, 45, and 46 the plants were dying and very nearly dead.

In No. 47 the plants were all quite dead.

As the growth was affected by the smallest quantity taken (Pot 41), three pots were resown on November 28th, with smaller proportions of salt:—

No. 49 with ·025 per cent. NaCl.

„ 50 „ ·050 „ „

„ 51 „ ·075 „ „

All these germinated well and were growing well on January 15th, 1903, showing that a quantity of NaCl below ·1 per cent. has no injurious action on the growth of maize.

From the above it is concluded that the germination of maize is unaffected by the presence in the soil of sodium chloride up to ·2 per cent., and that between ·4 and ·5 per cent. prevents germination.

The growth of the plant is markedly affected by ·1 per cent. of sodium chloride, and plants will not grow in soil containing ·25 per cent. and upwards.

Experiments with sodium carbonate.

Eight pots were filled with soil, manured with 10 grms. superphosphate each, and sown with 7 maize-kernels on October 24th, 1902. The quantities of sodium carbonate previously added to the different pots were as follows:—

No. 52, ·10 per cent. Na_2CO_3

„ 53, ·20 „ „

„ 54, ·25 „ „

„ 55, ·30 „ „

„ 56, ·35 „ „

„ 57, ·40 „ „

„ 58, ·50 „ „

„ 59, ·60 „ „

On November 3rd the following notes were made as to their germination:—

No. 52 had germinated perfectly.

In Nos. 53 and 54 the germination was slightly retarded, more so in 55 and 56; very much retarded in 57, whilst the seeds of 58 and 59 had not germinated.

The growth of all was more or less affected.

On November 21st the plants of pot 52 were growing well, though the effect of carbonate of soda was noticeable. This was somewhat more marked in 53, whilst in 54 the growth was strongly affected, and in 55, 56, 57, 58 and 59 the plants were all dead.

The conclusions drawn are the following:—Quantities up to .1 per cent. carbonate of soda in the soil are tolerated by the maize plant, and are without effect upon the germination or subsequent growth. .1 per cent. already acts as a poison to the growing plant, the effect of which is more and more marked up to between .25 and .30 per cent. at which point the plants die. The germination is slightly affected by .2 per cent., and .5 per cent. prevents germination.

Experiments with ammonium sulphocyanide.

Six pots were prepared as in the previous experiments with the following quantities of sulphocyanide, and sown on October 24th:—

No. 60,	.001	per cent.	NH ₄ CNS.
„ 61,	.002	„	„
„ 62,	.003	„	„
„ 63,	.004	„	„
„ 64,	.005	„	„
„ 65,	.006	„	„

On November 3rd, Nos. 60 to 63 had germinated well. In Nos. 64 and 65 the foliage had become spotted.

On November 21st, Nos. 60 to 63 were growing fairly, though all showed signs of the effect of the salt, and were not so vigorous as the check plants. Nos. 64 and 65 had recovered in colour but the growth was somewhat stunted.

Three more pots were sown on November 28th, containing somewhat larger proportions of sulphocyanide:—

No. 66, .008 per cent.

„ 67, .01 „

„ 68, .02 „

Nos. 66 to 67 germinated fairly but slowly and not vigorously, and No. 68 was somewhat more retarded. Their subsequent growth (January 15th, 1903) was more strongly affected.

The results show that proportions of ammonium sulphocyanide as low as .001 per cent. already affect the growth of the plant, though it will germinate freely until the amount reaches about .005 when the germination is not so vigorous and the young leaves are discoloured. The points at which germination and growth are actually prevented was not reached, but they are certainly very near .02%. A further series will have to be sown in order to establish this point.

Experiments with sodium chlorate.

Six pots were prepared as in the previous instance with the following quantities of sodium chlorate:—

No. 69, .001 per cent. NaClO_3

„ 70, .002 „ „

„ 71, .003 „ „

„ 72, .004 „ „

„ 73, .005 „ „

„ 74, .006 „ „

The results are as follows:—November 3rd, Nos. 69, 70, and 71 had germinated freely, No. 72 showed the effects of the salt, germination being slightly retarded. In No. 73 the foliage was discoloured, and in 74 the germination was very feeble and the young leaves discoloured and puny.

On November 21st the growth in No. 69 was fair but distinctly affected. In Nos. 70 and 71 the growth was more

strongly affected, the leaves in 71 having a bleached appearance. In 72, 73, and 74 the leaves were quite bleached and the plants dying.

It is thus seen that germination is unaffected till the amount of chlorate reaches $\cdot 004\%$, and that quantities above $\cdot 006\%$ prevent germination. The growth of the plant is affected by $\cdot 001\%$ and when the amount reaches $\cdot 004\%$ the plant is killed.

Experiments with arsenious acid.

Six pots were filled and sown on October 24th, the following quantities of arsenious acid having been previously added:

No. 75,	$\cdot 05$	per cent.	As_2O_3
„ 76,	$\cdot 10$	„	„
„ 77,	$\cdot 20$	„	„
„ 78,	$\cdot 30$	„	„
„ 79,	$\cdot 40$	„	„
„ 80,	$\cdot 50$	„	„

On examining the pots on November 3rd germination was found to be unaffected except in the case of No. 80 in which the germination was somewhat retarded.

On November 21st the growth of No. 75 was very slightly affected, the effect increasing in the succeeding numbers. In No. 77 the growth was somewhat stunted and more markedly so in 78, 79 and 80, though the plants were small they looked fairly healthy.

Three other pots were sewn on November 28th:—

No. 81,	$\cdot 60$	per cent.	As_2O_3
„ 82,	$\cdot 70$	„	„
„ 83,	$\cdot 80$	„	„

On December 13th it was found that the germination had been affected in all cases. In No. 83, it was very strongly affected and the plants were very feeble. Above

this point germination would certainly be prevented. The plants in Nos. 81 and 82 were nearly dead by January 15th and in 83 quite dead.

The germination of maize is therefore not affected by the presence of arsenic in the soil up to $\cdot 4\%$, at $\cdot 5\%$ however, germination is affected, and is prevented by quantities above $\cdot 8\%$; $\cdot 05\%$ has an effect upon the growth of the plant and $\cdot 20\%$ produces stunted plants, $\cdot 6$ to $\cdot 7$ being enough to prevent their growth.

These results are tabulated below:—

Effect upon germination and subsequent growth of Maize of different percentages of injurious substances in the soil.

	Germination affected.	Germination prevented.	Growth affected.	Growth prevented.
NaCl	$\cdot 20$	$\cdot 50$	$\cdot 10$	$\cdot 25$
Na ₂ CO ₃	$\cdot 20$	$\cdot 50$	$\cdot 10$	$\cdot 25$
NH ₄ CNS	$\cdot 005$	above $\cdot 02$	$\cdot 001$	above $\cdot 02$
NaClO ₃	$\cdot 004$	above $\cdot 006$	$\cdot 001$	$\cdot 004$
As ₂ O ₃	$\cdot 50$	above $\cdot 80$	$\cdot 05$	$\cdot 60$



Guthrie, Frederick Bickell and Helms, Richard. 1903. "Pot experiments to determine the limits of endurance of different farm-crops for certain injurious substances." *Journal and proceedings of the Royal Society of New South Wales* 37, 165–171. <https://doi.org/10.5962/p.359407>.

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