SUGAR BEET

SUGAR BEET SEED PRIMING

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ADAS Soil Science Department (Eastern Region) have shown that seeds imbibing dilute hydrogen peroxide in petridish tests germinate much faster than when imbibing distilled water or 10 mM nitrate solution. A much larger proportion of seeds germinated more quickly. Radicle elongation and plumule growth proceeded normally as long as the growing tissue was not in contact with hydrogen peroxide, but, when in contact, extensive suberisation of tissue occurred and growth was checked.

When seeds of the varieties Bush Mono and Monotri were separated by flotation in water the hydrogen peroxide effect nearly compensated for the slowness of germination of the seed grade <1 g/cc of both varieties. Similar results were obtained when seeds after soaking in hydrogen peroxide were dried back to their original moisture state before sowing in soil. Following these results sufficient seed for a field experiment was treated with dilute hydrogen peroxide.

METHOD

Commercial grade sugar beet seed that had been prepared normally up to the point of pelleting was separated into density categories by flotation in water (less than 5 minutes) and dried back to the original moisture content. A sample of the commercial grade seed and of seed >1 g/cc density were 'primed' by soaking in 0.2% (w/v) hydrogen peroxide for 10 hours in the laboratory and dried back to their original moisture state. The quantity of seed treated was insufficient for pelleting but it was treated with a seed dressing of Dieldrin before sowing.

Treatments:

Variety

Bush Mono G
Amono
Nono

Seed Priming

Commercial seed
Commercial seed primed with H_2O_2
Seeds >1 g/cc density primed with H_2O_2

Spacing

9.5 cm Hand singled
19.0 cm Drilled to a stand

The 9.5 cm spacing was hand singled to allow sugar yields to be compared at a constant plant density. The 19.0 cm spacing was included as a commercial practice treatment where factors such as per cent establishment, speed of emergence and seedling vigour are integrated in their effect on sugar yield.

The experiment was drilled on 24 March into a fine moist seedbed. The pattern of seedling emergence was determined from counts made on 7, 9, 12, 15, 17, 23 April and 13 May. Seedlings from 2 m^2 were collected on 17 May, washed and dried, for determination of seedling dry weight. The hand singling treatment was carried out on 19 May to give a regular distribution of 75,000 plants/ha. The experiment was hand harvested in November.

RESULTS

The mean seedling numbers from the two seed spacings are given in the following table.

Seedling emergence plants/ha (thousands)

Variety	Comm. (control)	Comm. + H_2O_2	>1 g/cc + H_2O_2	Comm. (control)	Comm. + H_2O_2	>1 g/cc + H_2O_2	Comm. (control)	Comm. + H_2O_2	>1 g/cc + H_2O_2
		7 April			9 April			12 April	
		(±1.4)			(±2.5)			(±5.7)	
Bush Mono G	0	2	1	2	22	12	62	75	66
Anono	0	2	0	1	18	11	26	55	70
Nono	0	29	8	4	59	39	55	85	94
		(±0.8)			(±1.5)			(±3.3)	
Mean	0	11	3	2	33	21	47	71	76
		15 April			17 April			13 May	
		(±5.6)			(±4.9)			(±4.3)	
Bush Mono G	95	100	94	117	112	112	141	132	137
Anono	62	80	98	79	91	113	109	111	137
Nono	98	105	114	105	103	125	149	134	153
		(±3.2)			(±2.9)			(±2.5)	
Mean	85	95	102	100	102	117	133	125	143

The first seedling emergence count was made 14 days after sowing and clearly showed a higher seedling population from the commercial grade seed treated with hydrogen peroxide. This more rapid emergence was maintained until 17 April (24 days after sowing) but by the final count of seedling establishment on 13 May the commercial seed (control) gave a slightly higher seedling number than that primed with hydrogen peroxide.

The seed of >1 g/cc density + H_2O_2 also showed more rapid early emergence than the control but initially was rather less rapid than the commercial seed + H_2O_2. However by the 19th day after sowing the >1 g/cc seed + H_2O_2 gave the higher plant number, this advantage was subsequently maintained.

An interaction between variety and seed priming on speed of seedling emergence was noted. Bush Mono G responded least to treatment with hydrogen peroxide whether commercial grade or the seed fraction >1 g/cc density. In contrast the variety Nono showed the greatest improvement from the seed priming treatment particularly in the earlier stages of seedling emergence. Anono gave the least rapid emergence but the advantage in seedling number from priming was maintained for most of the period of seedling emergence and for seeds >1 g/cc + H_2O_2 this advantage persisted throughout to final seedling establishment.

The rate of seedling emergence was estimated by graphing the data. Compared with the commercial seed (control) the mean time taken to achieve half the final plant number was 2.2 days less from hydrogen peroxide treated commercial grade seed and 1.8 days less from seed >1 g/cc + H_2O_2. The most striking effect was on Nomo where the commercial seed + H_2O_2 and the >1 g/cc seed + H_2O_2 gave an advantage of 3.4 and 2.3 days respectively. For Anono the corresponding advantage was rathe ess at 2.3 and 2.5 days and for Bush Mono G only 1.3 and 0.2 days respectively.

Dry weight per seedling (mg) 54 days after sowing

Variety	Comm. 9.5 cm	Comm. 19.0 cm	Comm + H_2O_2 9.5 cm	Comm + H_2O_2 19.0 cm	>1 g/cc + H_2O_2 9.5 cm	>1 g/cc + H_2O_2 19.0 cm	Mean
			($\pm$21.7)				($\pm$8.8)
Bush Mono G	236	269	317	330	270	299	287
Anono	209	173	278	235	308	292	249
Nomo	196	213	267	306	283	332	266
			($\pm$12.5)				
Mean	213	218	288	290	287	307	
			($\pm$8.8)				
Mean	216		289		297		

The largest seedlings were from the variety Bush Mono G and the smallest from Anono with Nomo intermediate in value. Commercial seed + H_2O_2 gave a mean seedling dry weight of 289 mg compared with the commercial seed (control) at 216 mg. The >1 g/cc seed + H_2O_2 increased seedling dry weight to 297 mg. A variety seed priming interaction was observed in that seed >1 g/cc + H_2O_2 of the varieties Anono and Nomo produced seedlings of weight greater than the commercial grade seed + H_2O_2 but not for Bush Mono G. A curious variety and seed spacing interaction occurred in that Bush Mono G and Nomo gave the largest seedlings from the 19 cm spacing but for Anono seedlings at this wide spacing were the smallest.

Plant density at harvest (thousands/ha)

Variety	Comm. 9.5 cm	Comm. 19.0 cm	Comm. + H_2O_2 9.5 cm	Comm. + H_2O_2 19.0 cm	>1 g/cc + H_2O_2 9.5 cm	>1 g/cc + H_2O_2 19.0 cm	Mean
			(±2.4)				(±1.0)
Bush Mono G	76	96	75	92	77	94	85
Anono	74	78	72	75	78	92	78
Nono	76	90	76	91	77	103	86
			(±1.4)				
Mean	76	88	74	86	78	97	
			(±1.0)				
Mean	82		86		87		

The target plant density of 75 thousand/ha after hand singling was achieved whilst the drilled to a stand treatment averaged 88, 86 and 97 thousand plants/ha from the commercial, commercial + H_2O_2 and >1 g/cc + H_2O_2 respectively. The higher plant numbers from the >1 g/cc + H_2O_2 treatment was obtained for each variety.

There was no difference in sugar per cent due to variety or seed priming but the hand singled treatment averaged 14.8 and the irregular distribution given by drilling to a stand a little lower at 14.6% (S.E. ±0.06%).

Sugar yield (tonne/ha)

Variety	Comm. 9.5 cm	Comm. 19.0 cm	Comm. + H_2O_2 9.5 cm	Comm. + H_2O_2 19.0 cm	>1 g/cc + H_2O_2 9.5 cm	>1 g/cc + H_2O_2 19.0 cm	Mean
			(±0.319)				(±0.130)
Bush Mono G	7.70	7.56	7.68	7.84	8.07	7.81	7.78
Anono	6.90	6.83	7.16	7.45	7.59	7.53	7.25
Nono	7.61	8.08	8.37	9.05	8.16	9.27	8.42
			(±0.184)				
Mean	7.40	7.51	7.74	8.11	7.94	8.20	
			(±0.130)				
Mean	7.46		7.93		8.07		

Nono gave the highest sugar yield and Anono the lowest with Bush Mono G intermediate in yield. The mean effect of the seed priming treatments was to increase sugar yield by 0.47 and 0.61 tonne/ha from commercial + H_2O_2 and >1 g/cc + H_2O_2 treatments respectively. Compared with the commercial seed (control) the effect of seed priming with H_2O_2 was to increase yields by 2, 6 and 11 per cent for the varieties Bush Mono G, Anono and Nono respectively. For seeds >1 g/cc + H_2O_2 the corresponding responses were slightly greater at 4, 10 and 11 per cent respectively.

The relative order of these varieties in their response in sugar yield to seed priming seems consistent with the relative improvement in the rate of seedling establishment.

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