Seed&Field

Technical Report

Effect of seed size on onion crop establishment and performance

January 2025 S. Slack & R. Cox

Summary

A field trial was undertaken during the 2024-25 growing season to assess the effect of seed size on crop establishment and production. Results showed that larger sized seed offered several benefits including; greater seedling establishment, greater plant height, increased total bulb count, and improved gross and marketable yield. Increased yields appeared to be the result of an increase in total bulb numbers, and an increase in bulb number and weight within the 50-70mm, and 70-90mm diameter bulb categories.

Method

Experimental site and treatment details

Ungraded Seminis/S&F ELK seed (lot number MF24) was size graded into four seed diameter size treatments using commercial seed grading equipment. Standard seed analysis of number of seeds per gram, and germination testing was then conducted (Table 1). The graded seed treatments were then placed onto cellulose planting tape at 70mm seed spacing. An experimental area was established within a commercial onion planting of the cv. Seminis/S&F ELK in Buckland, New Zealand. The commercial crop was seeded on the 14th of June 2024, and the experimental treatments were seeded on the same day using a modified Earthway Seeder. The experimental design was a Randomised Complete Block Design (RCBD) with four treatment replicates. Plots were 10m in length and comprised of 8 evenly spaced rows on 1.72m wheel track centre to centre beds. The experimental area was treated as per the commercial crop in terms of agronomic inputs.

Table 1: Experimental treatment details

Treatment	Seeds/gram	Germination (Interim (7d)/ Final (12d)
<2.0mm	264	77/85
2.0-2.25mm	214	92/96
2.25-2.5mm	198	92/96
>2.5mm	174	92/94

Seedling establishment was assessed on the 8th of August 2024, at the time of assessment seedlings had a first true leaf standing at around flag leaf height. Establishment assessments were made by counting the number of seedlings present within a two bed-metre sampling area within each plot and is reported as mean stand count per bed metre.

Plant height was assessed on the 7th of October 2024, when the majority of seedlings were at around four true leaf. Plant height was assessed by measuring the length of the longest leaf on 25 randomly selected plants within the centre six rows of each plot.

At crop maturity on the 31st December 2024, one bed-metre samples were harvested from within each plot. After curing, bulbs were size graded into four bulb diameter categories; less than 50mm, 50-70mm, 70-90mm, and larger than 90mm. Bulb counts and weights were calculated for each category. Total yield/ha and marketable yield/ha were then able to be extrapolated from these figures. Marketable yield was calculated as the sum of the 50-70mm and 70-90mm categories.

Statistical analysis

Data were analysed using a 95% confidence interval. Analyses of variance (ANOVA) were computed using the statistical software ARM. Treatment means were separated using Duncans new multiple range test. As the LSD is computed using transformed data, comparisons of means should rely on the letters of separation, rather than the LSD value.

Results

Increasing seed size had a positive effect on seedling stand count, plant height, harvested bulb count, yield, and marketable yield (Table 2).

Seedling stand counts were significantly higher for the >2.5mm treatment than the <2.0mm and 2.0-2.25mm size treatments. The 2.25-2.5mm treatment did not differ significantly from either the 2.0-2.25mm or >2.5mm treatments, however it did have a significantly higher stand count than the <2.0mm treatment.

The >2.5mm treatment did not have a mean plant height that was significantly higher than the 2.25-2.5mm treatment. However, the >2.5mm and 2.25-2.5mm treatments had mean plant heights that were significantly taller than both the <2.0mm and 2.0-2.25mm size treatments.

The >2.5mm size treatment had a harvested bulb count that was significantly higher than the three other size treatments. The 2.0-2.25, and 2.25-2.5mm treatments did not differ significantly from each other, however, both had higher harvested bulbs counts than the <2.0mm treatment.

The >2.5mm treatment had a gross yield that was significantly higher than both the <2.0mm and the 2.0-2.25mm treatments. The 2.25-2.5mm treatment had a gross yield that did not differ significantly from the <2.0mm, 2.25-2.5mm, and the >2.5mm treatments.

Table 2: Effect of seed size on various agronomic characteristics within the cv. Seminis/S&F ELK planted on the 14th of June 2024 in Buckland, New Zealand.

Treatment	Stand Count (per bed m)	Plant Height (mm)	Bulb Count (per bed m)	Yield (t/Ha)	Marketable Yield (t/Ha)
<2.0mm	74.63 c	221.0 b	71.9 c	70.66 b	64.40 b
2.0-2.25mm	98.13 b	229.0 b	93.0 b	76.08 b	70.77 b
2.25-2.5mm	100.5 ab	275.8 a	92.8 b	79.13 ab	71.43 b
>2.5mm	102.47 a	284.6 a	100.5 a	87.62 a	80.11 a
LSD (p=0.05)	4.08	24.98	7.28	8.86	8.09
S D	2.50	15.62	4.36	5.30	4.84
CV	2.66	6.18	4.87	6.76	6.75
Shapiro-Wilk^	0.9738	0.9613	0.9871	0.9751	0.9475
P(Shapiro-Wilk)^	0.9101	0.6847	0.9976	0.9364	0.5232
Replicate F	2.743	11.640	3.112	0.261	0.957
Replicate Prob(F)	0.1128	0.0019	0.0978	0.8517	0.4640
Treatment F	107.915	17.054	32.026	7.168	7.115
Treatment Prob(F)	0.0001	0.0005	0.0002	0.0154	0.0157

* means followed by the same letter do not differ significantly (p=0.05, Duncans New MRT)

^ calculated from residual

The effect of seed size on the number and weight of bulbs falling into various size categories is shown in table 3.
The <2.0mm treatment had significantly less bulbs in the <50mm diameter bulb category than the three other treatments. There was no significant difference in the weight of bulbs in the <50mm diameter category.
The >2.5mm treatment had a significantly higher bulb count in the 50-70mm category, however total bulb weight did not differ significantly from any of the other treatments.
Bulb counts and weights did not differ significantly between any of the treatments in either of the 50-70mm, or the >90mm bulb size categories.

Table 3: Effect of seed size within the cv. Seminis/S&F ELK on the number and weight of bulbs in various size categories from within an onion crop planted on the 14th of June 2024 in Buckland, New Zealand.

Treatment	<50mm count	<50mm weight	50-70mm count	50-70mm weight	70-90mm count	70-90mm weight	>90mm count	>90mm weight
<2.0mm	9.3 b	0.61 -	39.2 b	5.42 -	22.7 -	5.658 -	0.7 -	0.30 -
2.0-2.25mm	18.3 a	0.91 -	50.8 ab	6.56 -	24.0 -	5.613 -	0.0 -	0.00 -
2.25-2.5mm	17.8 a	0.93 -	52.0 ab	6.80 -	23.0 -	5.488 -	0.0 -	0.00 -
>2.5mm	18.0 a	0.96 -	53.9 a	7.16 -	28.3 -	6.625 -	0.3 -	0.17 -
LSD (p=0.05)	6.48	0.411	12.90	1.933	10.41	2.5071	1.06	0.492
S D	3.87	0.210	7.72	1.156	6.23	1.4994	0.64	0.294
CV	24.46	25.28	15.76	17.82	25.41	25.65	254.54	252.05
Shapiro-Wilk^	0.9387	0.9517	0.9793	0.9766	0.9529	0.9329	0.9317	0.9311
P(Shapiro-Wilk)^	0.4021	0.6886	0.9705	0.9505	0.6073	0.3345	0.3227	0.3166
Replicate F	1.226	2.195	2.082	1.375	1.497	1.813	0.412	0.392
Replicate Prob(F)	0.3694	0.2311	0.1911	0.3270	0.2964	0.2326	0.7498	0.7627
Treatment F	5.022	3.321	2.954	1.684	0.707	0.489	1.006	0.977
Treatment Prob(F)	0.363	0.1413	0.1075	0.2564	5.776	0.7006	0.4448	0.4562

* means followed by the same letter do not differ significantly (p=0.05, Duncans New MRT)

^ calculated from residual

Conclusions

The >2.5mm seed size treatment offered significant improvements to stand establishment, plant height, bulb count, gross yield, and marketable yield. These results highlight the commercial advantage to the use of accurately graded, large seed sizes where they are available.
Future work will look to revalidate these results across a range of growing systems and varieties.

Photograph 1: Trial site overview.