

Standardisation of screen size and machine speed for grading sunflower seeds

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Abstract: In an attempt to find out a suitable sieve size and machine speed for grading sunflower seeds in a two screen cleaner cum grader, performance of various sieve sizes (round perforated) and machine speed on seed quality was studied. Decrease in sieve aperture size from 5.5 to 4.5 mm and increase in machine speed from 150 to 225 rpm improved the recovery percentage. However, the physical attributes such as seed length, width, and weight decreased with the decrease in sieve aperture size and increase in grading speed. Germination was higher in seeds retained on 5.5 mm sieve (98.0%) and lower in seeds passed through 4.5 mm sieve (86.0%). The seedling growth and vigour parameters also showed a similar trend. Germination, seedling growth and vigour index of seeds graded at a midrange speed of 175 to 200 rpm were more compared to the extreme speeds of 150 and 225 rpm. For maximum recovery and better sowing quality, grading sunflower seeds using 4.5 mm sieve at a speed range of 175 to 200 rpm was found to be optimum.

Key words: Seed grading, seed recovery, seed quality, sieve size, sunflower.

Introduction

Improved crop varieties become production inputs only when high quality seed is available to cultivators in adequate quantities at the right place and right time (Gregg, 1973). A considerable amount of quality seeds are being lost during cleaning and grading as under-sized seeds due to the use of unsuitable sieves (Radhakrishnan Maiya *et al.* 2001) and other machine adjustments (Gregg, 1973). To avoid this loss and to improve the availability of seed material without sacrificing the seed quality, it is necessary to process the seeds with optimum sieves and machine speed. Sunflower (*Helianthus annuus* L.) is one of the major oilseed crops with high level of oil content (40 to 50 %). With the increasing demand for sunflower seeds, it is necessary to meet out the demand. There is a great relevance of seed germination and seed vigour for initial assessment of crop productivity. The seed processing engineer should optimise the seed recovery and seed quality in such a way that there should be maximum recovery of seed which meets the quality standards. (Kanawade *et al.* 2000). The present study was therefore, carried out at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore to optimize the sieve

size and machine speed for grading sunflower seeds in a two screen cleaner cum grader.

Materials and Methods

Freshly harvested seeds of sunflower cv. CO 3 were collected and used for processing in a laboratory model two screen cleaner cum grader. The seed samples weighing 1000 g each were graded using a 6 mm round perforated top screen (scalper) and three different grading screens (round perforated), those aperture size measuring 5.5, 5.0 and 4.5 mm. The grading operation was carried out with variable speeds at 150, 175, 200 and 225 rpm using all the three grading screens mentioned above. The feed rate (@ 1 kg minute⁻¹), stroke length and sieve inclination were kept at constant during the grading operation. The material riding over the grading screen was considered as product to determine the recovery per cent and that sinking through as reject. Recovery and rejection fractions were quantified for each grading operation consist of a screen size and motor speed combination. Random samples were drawn from both the fractions at delivery end at a steady state. The seed samples were observed for physical quality traits viz. length, width and weight and the physiological quality traits viz. germination,

Table 1. Recovery and rejection per cent of sunflower cv. CO 3 seeds graded by different sieves at variable machine speed

Sieve aperture size (mm)	Machine speed (rpm)							
	Recovery %				Rejection %			
	150	175	200	225	150	175	200	225
5.5	44.1	41.2	55.7	69.4	55.9	58.7	43.9	30.6
5.0	61.3	71.9	78.0	88.5	38.7	28.1	22.1	11.5
4.5	86.6	84.2	85.5	93.1	13.3	15.7	14.5	6.9

seedling length, dry matter production and vigour index and the data were recorded. The data were scrutinised using the statistical tools prescribed by Panse and Sukhatme (1976) and the results are presented here.

Results and Discussion

i. Seed recovery

The efficiency and effectiveness of cleaning and grading operation is affected by the equipment available and its setting arrangements (Gregg, 1973). In the present study, recovery of sunflower seeds was highest at a machine speed of 225 rpm in 4.5 mm sieve (93.1%) followed by 5.0 mm sieve (88.5%). It was observed that as the sieve aperture size decreased from 5.5 mm to 4.5 mm and the machine speed increased from 150 to 225 rpm, there was a gradual increase in the recovery per cent and decrease in the rejection per cent (Table 1). Similar trend was obtained by Shashidhara *et al.* (1988) in maize and Ramaiah *et al.* (1994) and Kanawade *et al.* (2000) in sunflower.

ii. Physical quality

Size is the most common difference among seed, and between seed and contaminants (Gregg, 1973). The data on physical measurements of seed samples collected during various grading combinations also showed significant difference in size distribution. The mean seed length ranged from 9.4 mm (sinkers of 4.5 mm sieve) to 10.9 mm (retained by 5.5 mm sieve) with a bulk mean of 10.5 mm. The mean seed width ranged from 3.9 mm (sinkers of 4.5 mm sieve) to 4.9 mm (retained on 5.5 mm sieve) with a bulk mean of 4.7 mm. The

100 seed weight recorded by seeds retained on 5.5 mm sieve was more (3.77 g) and was less in the sinkers of 4.5 mm (2.48 g). The seed weight of bulk was 3.61 g. It was also observed that with the increase in machine speed from 150 to 225 rpm, the physical properties of seeds gradually reduced (Table 2).

iii. Germination and seedling vigour

Maximum germination was recorded by seeds retained by 5.5 mm sieve (98.0%) and minimum germination by seed sunk through 4.5 mm sieve (86.0%). This may be due to average increase in seed size and weight with the increase in grading screen size (Kanawade *et al.* 2000). The rest of the grades and bulk seeds recorded similar germination per cent with 90.0 to 92.0 per cent. All the other physiological traits *viz.* root and shoot length, drymatter production, and vigour index were also significantly influenced by seed size (Table 3 and 4). This may be due to the greater amount of food reserves contained and the greater embryo size or both (Wood *et al.* 1977; Palanisamy and Ramasamy, 1985). The difference in seed vigour may also be attributed to the difference in seed index between different seed size groups (Davis, 1967). Interestingly, the lowest and the highest speeds (150 and 225 rpm) recorded a lower germination of 90.8 per cent than the midrange speeds (175 and 200 rpm) with 95.0 per cent. All the seedling growth and vigour parameters also showed a similar trend. This could be attributed to the improper grading operation in the extreme speeds resulted in poor physiological condition of the seeds. Therefore, considering the high recovery per cent and significantly better sowing quality,

Table 2. Physical characteristics of sunflower cv. Co 3 seeds retained and passed through different screen sizes at variable machine speed

Sieve aperture size (mm)	Seed length (cm)					Seed width (cm)					100 seed weight (g)				
	Machine speed (rpm)					Machine speed (rpm)					Machine speed (rpm)				
	150	175	200	225	Mean	150	175	200	225	Mean	150	175	200	225	Mean
5.5 R	1.08	1.11	1.08	1.07	1.09	0.48	0.50	0.49	0.47	0.49	3.81	3.96	3.73	3.61	3.77
5.5 P	1.04	1.01	1.04	1.01	1.03	0.41	0.44	0.45	0.42	0.43	2.96	2.95	3.01	2.73	2.91
5.0 R	1.08	1.02	1.04	1.03	1.04	0.49	0.47	0.46	0.43	0.46	3.74	3.79	3.51	3.20	3.56
5.0 P	1.00	0.99	1.01	0.99	1.00	0.41	0.42	0.43	0.41	0.42	2.64	2.56	2.62	2.38	2.55
4.5 R	1.03	0.99	1.00	0.98	1.00	0.44	0.45	0.46	0.44	0.45	3.56	3.45	3.56	3.28	3.46
4.5 P	0.97	0.93	0.95	0.92	0.94	0.38	0.41	0.39	0.38	0.39	2.34	2.46	2.64	2.46	2.48
Bulk	1.05	1.05	1.05	1.05	1.05	0.47	0.47	0.47	0.47	0.47	3.61	3.61	3.61	3.61	3.61
Mean	1.05	1.04	1.04	1.02		0.45	0.46	0.46	0.44		3.55	3.49	3.39	3.17	

R = Retained P = Passed through

CD (P=0.05)

0.016**

0.022**

NS

Speed (Sp)

Sieve (Se)

Sp x Se

CD (P=0.05)

0.014**

0.019**

0.038*

CD (P=0.05)

0.069**

0.097**

0.194**

Table 3. Mean germination (%), shoot length (cm) and root length (cm) of sunflower cv. Co 3 seeds retained and passed through different sieves at variable machine speed

Sieve aperture size (mm)	Germination (%)					Root length (cm)					Shoot length (cm)				
	Machine speed (rpm)					Machine speed (rpm)					Machine speed (rpm)				
	150	175	200	225	Mean	150	175	200	225	Mean	150	175	200	225	Mean
5.5 R	96	100	98	98	98.0	16.2	13.0	15.8	14.7	14.9	15.5	17.4	17.4	13.9	16.1
5.5 P	92	98	98	90	94.5	14.2	14.1	13.8	14.5	14.2	11.9	15.5	15.6	13.8	14.2
5.0 R	94	100	98	90	97.0	15.5	15.6	15.3	12.5	14.7	15.9	15.6	16.2	15.3	15.8
5.0 P	86	94	96	90	91.5	13.0	12.7	13.5	14.8	13.5	13.2	13.6	14.0	12.7	13.4
4.5 R	93	94	92	92	90.5	14.4	15.7	14.4	13.7	14.6	12.5	15.2	15.9	14.3	14.5
4.5 P	82	88	90	84	86.0	9.5	10.5	12.9	12.7	11.4	11.8	12.0	12.7	12.2	12.2
Bulk	92	92	92	92	92.0	14.1	14.1	14.1	14.1	14.1	14.5	14.5	14.5	14.5	14.5
Mean	90.7	95.1	94.9	90.9		13.8	13.7	14.3	13.8		13.6	14.8	15.2	13.8	

R = Retained; P = Passed through CD (P=0.05)

1.58**

2.23**

4.47*

CD (P=0.05)

NS

1.59**

NS

CD (P=0.05)

0.47**

0.66**

1.32**

Table 4. Mean drymatter production (g) and vigour index of sunflower cv. CO 3 seeds retained and passed through different screen sizes at variable machine speeds

Sieve aperture size (mm)	Machine speed (rpm)									
	Drymatter production (g)					Vigour index				
	150	175	200	225	Mean	150	175	200	225	Mean
5.5 R	0.131	0.147	0.140	0.124	0.136	3043	3030	3250	2807	3033
5.5 P	0.107	0.120	0.121	0.100	0.112	2397	2901	2883	2541	2681
5.0 R	0.112	0.128	0.126	0.111	0.119	2954	3110	3082	2496	2911
5.0 P	0.100	0.105	0.101	0.097	0.101	2254	2466	2650	2470	2460
4.5 R	0.096	0.105	0.109	0.099	0.102	2493	2898	2788	2572	2688
4.5 P	0.085	0.096	0.102	0.092	0.094	1745	1976	2305	2087	2028
Bulk	0.124	0.124	0.124	0.124	0.124	2627	2627	2627	2627	2627
Mean	0.108	0.118	0.118	0.107		2501	2715	2798	2514	

R = Retained P = Passed through

	CD (P=0.05)	CD (P=0.05)
Speed (Sp)	0.0034**	113.60
Sieve (Se)	0.0048**	160.66**
Sp x Se	0.0010**	NS

sunflower seeds can be efficiently and effectively graded using a round perforated 4.5 mm sieve at a speed range of 175 to 200 rpm.

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