

วารสารเกษตร 5, 2: 91 - 98 (2532)

Journal of Agriculture 5, 2: 91 - 98 (1989)

THE EFFECT OF THRESHER SPEEDS ON SEED LOSS: RETAINING WHEAT SEED QUALITY

Suchada Vearasilp, Nongluck Prakobboon and Surat Nuk-lor

ABSTRACT : being concerned with retaining wheat seed quality, both the use of a wheat thresher and beating with bamboo sticks were examined for comparative seed loss. The testing of the thresher was done using 5 different drum speeds : 1,000, 900, 800, and 700 rpm. Results show that neither fast nor slow threshing affect the quantity of seed produced. Within total losses, the main loss occurred as unthreshed seed in plant residue. Discarded seed, the percentage of broken seed and threshing time did not vary between treatments. Loss was at a minimum after beating with bamboo sticks. Tin cans proved to be good containers. Seed quality after 7 months storage was satisfactory.

INTRODUCTION

Proper threshing is recognized as one of the main factors behind the production of high quality seed. In wheat production, an improperly adjusted thresher will lead to the loss of a large proportion of the seed crop. Similarly, high speed or unsuitable handling equipment is seen as the cause behind chipped, cut, broken or otherwise damaged seed. It has been found that the higher the drum speed the greater the loss (Kradanga, *et, al.*, 1980., Limpiti, 1987). Losses occur due to the seed being broken by the threshing drum and the grain then being blow away by the cleaning fan. The study of the factors affecting threshing losses is therefore of interest.

Mechanical injury during processing can be a major cause underlying the reduction of seed viability before and during storage. Damaged seed is more susceptible to stroage fungi and insects and experiences both a faster physiological deterioration due to exposure to air and a more rapid decline in seed quality and germination rate.

Seed containing a low moisture content are easily split and broken after processing (Bunch, 1960., Kulik, 1973., Stanway, 1977). Seed with a higher moisture content are more tolerant but bruising within the seed is often seen (Toole. 1960., Moore, 1972). Besides that effect of sizes, species. shapes and seed components are affected from mechanical processing differently.

Department of Agronomy, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50002, THAILAND.

Seed units in cereal crops vary according to specie. For example, the seed unit for barley and rice consists of the caryopsis plus lemma and palea (floret). The seed unit for sorghum and some millets consists of the caryopsis plus lemma, palea, outer glumes and inner glumes (spikelet). But the seed unit for wheat consists solely of the caryopsis (fruit). Among all cereal seed therefore the naked wheat seed would appear to be the most susceptible to mechanical damage.

The aim of the experiment therefore was to compare the ratios of threshing loss to seed quality produced by different threshing speeds.

MATERIALS AND METHODS

Wheat seeds of the cultivar Inia 66 were sown at Khun Pae Experimental Station and harvested in April 1987. The harvested wheat was divided into 5 lots of 20 kgs and then each lot was threshed by one of 5 different methods:

- wheat thresher with drum speed 1000 rpm
- wheat thresher with drum speed 900 rpm
- wheat thresher with drum speed 800 rpm
- wheat thresher with drum speed 700 rpm
- beating with bamboo sticks after being placed in muslin cloth bags.

At the time of threshing the seed moisture content was approximately 12 %. The thresher was a 4 horsepower, throw-in model without cleaning unit. In order to determine whether complete threshing had been achieved, the weights of the threshed seed, of the unthreshed seed found in plant residue at the disposal outlet and of seed blown out by the fan were examined. Threshing time were also recorded. A 1 kg sample was taken from each of the 5 seed lots collected from the seed outlet in order to determine the amount of broken seed. Threshed seed were cleaned by an air-screen cleaner. 3 kgs of cleaned seed from each treatment were placed in tin cans and stored for 7 months (April to November, 1987) under ambient conditions in the Seed Laboratory, Department of Agronomy, Faculty of Agriculture, Chiang Mai University.

To determine quality, seed samples were collected at the beginning of storage and thereafter every month for a standard germination test, field emergence test and moisture content determination.

The experimental data were statistically analyzed using a completely randomized design with 3 replications and the Duncan Multiple Range Test (DMRT) for comparison between treatment means.

RESULTS AND DISCUSSION

Wheat Seed Loss According to Threshing Speed

The effect of drum speed and of threshing method on seed loss are summarized in Tables 1 and 2. There was no statistically significant difference on the weight of threshed seed to be found from either the use of high or low drum speed. The percentages of unthreshed seed in plant residue however were found to be significantly different. A drum speed of 1000 rpm produced the highest percentage rate of lost unthreshed seed. By weight this was 1,016.4 g. A drum speed of 700 rpm produced a much better and lower seed loss rate of 234.3 g.

There was no statistically significant difference between the amounts of seed carried out with plant residue according to drum speed. However, it was found that the higher the speed the higher the percentage of broken seed, but that this was less than 0.2 % of all speeds. There was no statistically significant difference in the amount of threshed seed produced by each drum speed but the lowest loss 421.9 g was that incurred by 700 rpm.

The largest loss in the experiment was incurred as unthreshed seed in plant residue. Either 1000 rpm or improper clearance between drum and concaves at this speed caused incomplete threshing of seed heads. The loss of good seed blown out with straw in this experiment was of an acceptable level and means that the fan was properly adjusted. The result of a less than 0.2 % broken seed loss in all treatments due to either excessive drum speed or insufficient clearance between drum and concaves was also acceptable but damaged seed was expected to be carried through and revealed in the standard germination test. Normally, visibly broken seed and breaks in the seed coat which may be invisible without a magnifying glass lead to a lower seed quality.

Differences in times required for different threshing speeds were not statistically significant. All speeds required less than 4 minutes to thresh 20 kgs of harvested wheat plant. Threshing at 700 rpm took the longest time of 3.49 minutes. Seed were not carried away by wind or in plant residue when threshing was done by beating. Broken seed by this treatment constituted a minimum of 0.018 %.

In general, therefore, the wheat thresher operating at all peripheral speeds still gave good results with minimal overall losses. Unthreshed and thrown out seed did not significantly subtract from the amount of threshed seed.

Table 1. Losses in gram of wheat seed as a function of either mechanical threshing and different drum speeds or hand threshing.

Speed of thresher (rpm)	Threshed seed (g)	Unthreshed seed (g)	Thrown out seed (g)	Total loss (Unthreshed + thrown out seed) (g)	Threshing time (minutes)
1000	10,150	1,016.4 ^a	73.9	2.32	1,090.3 ^a
900	10,200	597.2 ^b	161.8	2.54	759.6 ^b
800	10,400	377.9 ^c	177.6	2.87	555.6 ^{bc}
700	10,600	234.3 ^c	187.6	3.49	421.9 ^c
By hand	10,135	0	0	-	-
F-test	NS	**	NS	NS	**

** = Significant at $P < 0.01\%$

NS = Non-significant

Initial weight (Straw + Awn + Seed) before threshing 20,000 g.

Table 2. Percentage losses of wheat seed as a function of either mechanical threshing and different drum speeds of hand threshing.

Speed of thresher (rpm)	Threshed seed (%)	Unthreshed seed (%)	Thrown out seed (%)	Total loss (Unthreshed + thrown out seed) (%)	Broken seed (%)
1000	50.75	5.08	0.37	5.45	0.15
900	51.00	2.99	0.81	3.80	0.10
800	52.00	1.89	0.89	2.78	0.07
700	53.00	1.17	0.94	2.11	0.02
By hand	50.67	0	0	-	0.02
F-test	NS	**	NS	**	

** = Significant at $P < 0.01\%$

NS = Non-significant

Initial weight (Straw+awn+seed) before threshing = 100 %

Table 3. Germination percentage of wheat seed as a function of either mechanical threshing and different drum speeds or hand threshing, and after storage in tin cans under ambient temperatures for up to 7 months.

Drum speeds and threshing method (rpm)	Germination (%) ¹							
	OM ² Apr 87	1 M May	2 M Jun	3 M Jul	4 M Aug	5 M Sept	6 M Oct	7 M Nov
1000	98	90	88	87 ^b	86 ^b	86 ^{bc}	84 ^d	79 ^c
900	99	91	91	88 ^b	86 ^b	84 ^c	88 ^c	79 ^c
800	98	97	95	94 ^a	92 ^{ab}	92 ^{ab}	92 ^b	88 ^b
700	99	98	98	97 ^a	98 ^a	96 ^a	96 ^a	95 ^a
By hand	99	98	98	97 ^a	98 ^a	96 ^a	96 ^a	95 ^a
F-test	NS	NS	NS	**	**	**	**	**

** = Significant at P < 0.01 %

NS = Non-Significant

1 average of 3 replications

2 Months of storage

Column means followed by the same letter are not significantly different at 1 % level of DMRT.

Table 4. Field emergence percentage of wheat seed as a function of either mechanical threshing and different drum speeds or hand threshing and after storage in tin cans under ambient temperatures for up to 7 months.

Drum speeds and threshing method (rpm)	Field emergence (%) ¹							
	OM ² Apr 87	1M May	2M Jun	3M Jul	4M Aug	5M Sept	6M Oct	7M Nov
1000	94 ^c	76 ^d	73 ^e	72 ^c	66 ^b	55 ^c	48 ^c	38 ^d
900	93 ^d	81 ^c	76 ^d	74 ^c	77 ^b	58 ^c	52 ^c	55 ^c
800	96 ^{bc}	82 ^c	81 ^c	80 ^b	79 ^a	77 ^b	72 ^b	59 ^b
700	97 ^b	88 ^b	87 ^b	83 ^b	82 ^a	81 ^{ab}	73 ^{ab}	59 ^b
By hand	99 ^a	98 ^a	97 ^a	95 ^a	83 ^a	85 ^a	78 ^a	67 ^a
F Test	**	**	**		**	**	**	**

** = Significant at P < 0.01 %

1 Average of 3 replications

2 Months of storage

Column means followed by the same letter are not significantly different at 1 % level of DMRT.

Table 5. Moisture content percentage of wheat seed as a function of either mechanical threshing and different drum speeds or hand threshing, and after storage in tin cans under ambient temperatures for up to 7 months.

Drum speeds and threshing method (rpm)	Moisture content (%) ¹							
	OM ² Apr 87	1M May	2M Jun	3M Jul	4M Aug	5M Sept	6M Oct	7M Nov
1000	9.50	9.57	9.52	9.51	9.40	9.56	9.45	9.69
900	9.47	9.11	9.44	9.63	9.61	9.43	9.32	9.63
800	9.60	9.86	9.43	9.38	9.82	9.57	9.70	9.42
700	9.40	9.66	9.24	9.53	9.80	9.55	9.51	9.82
By hand	9.30	9.22	9.43	9.84	9.40	9.48	9.47	9.69
F	NS	NS	NS	NS	NS	NS	NS	NS

NS = Non-Significant

1 Average of 3 replications

2 Months of storage

Column means followed by the same letter are not significantly different at 1 % level of DMRT.

Wheat Seed Quality According to Threshing Speed

Germination Test

The germination percentages of seed threshed at different drum speeds and which were stored in tin cans are shown in Table 3. The germination percentage of seed after 3 months of storage was no statistically significantly different and all treatments recorded higher than 80 %. After 4 months storage seed threshed at higher speeds started to decline in viability faster than that threshed at lower speeds. Seed threshed at 1000 rpm decreased in viability slowly and gave the lowest germination rate during all months in storage. Conversely, that seed threshed by hand beating showed the highest germination rate of more than 95 % for all storage months.

FIELD Emergence Test

The results of the field emergence test for threshed seed are given in Table 4. The field emergence percentages were lower than those for the germination test. The use of the thresher at all speeds lead to a decline in seed quality from the first month of storage. The use of high drum speed clearly affected seed viability. On the other hand, after 7 months storage seed threshed by hand beating gave the highest field emergence percentage of 67 % which is higher than that for seed mechanically threshed at all speeds.

The field emergence test is one of the most useful ways to determine seed vigour. Invisible mechanical damage is very difficult to identify in seed. The results of the germination test could not show exactly the amount of mechanically damaged seed. Most of the damaged seed which did germinate in the laboratory emerged but presented non-uniform stands in the field. The results show that the higher the drum speed, the lower the field emergence percentage.

Moisture Content Determination

There was no statistically significant difference between threshing speeds in moisture content of seed kept in tin cans and under ambient conditions. The seed moisture contents before and after 7 months storage were lower than 10 %. The tin can proved to be a most suitable container for moisture-proof storage.

CONCLUSIONS

Studying 4 different thresher drum speeds showed that whether high or low drum speed was used there was no statistically significant gain in threshed seed. Losses due to unthreshed seed being found in plant residue was the main loss within total losses. It was also found that the higher the drum speed, the higher the seed loss. Seed thrown out by wind, the percentage of broken seed and threshing times required were not significantly different between treatments. It can be surmised that uncontrolled excessive drum speed lead to the remaining loss of unthreshed seed. Accordingly, the thresher drum speed for wheat seed is 700 rpm. Calibrated fan speed minimized the amount of good seed blown out with straw. The lowest threshing loss was incurred by hand beating with bamboo sticks.

The tin can proved to be a good moisture-proof container. Storing wheat seeds in this way for 7 months gave satisfactory results. Seed maintained a relatively low moisture content throughout the storage period. Proper storage conditions like moistureproof containers can not help mechanically damage seed which are threshed from higher drum speed thresher to maintain their qualities. The invisibly damaged seed mentioned above rapidly deteriorated and their storage life was short. Inhibiting a low germination rate can be achieved by using the appropriate threshing speed and storage conditions. Nonetheless, when comparing wheat seed with oil seed like soybean, wheat seed survives longer and is more tolerant of mechanical damage.

REFERENCES

- Bunch, H.D.(1960). Relationship between moisture content of seed and mechanical damage in seed conveying. *Seed World*. 86 :14-17.

- Kradanga, P., Daosaad, S. and Sirichaimanus, K.(1980). Improve of thresher performance. Annual Report on Research and Development. Department of Agriculture. Ministry of Agriculture and Cooperative Bangkok.
- Kulik, M.M.(1973). Retention of germinability and invasion by storage fungi of hand threshed and machine threshed wheat seeds in storage. Seed Science and Technology. 1:805-810.
- Limpiti, S. (1987). The factors affecting losses of soybean during threshing. Final report (1987) to asian crops postharvest programme. Postharvest Technology Research and Training Center. Faculty of Agriculture, CMU.
- Moore, R.P. (1972). Effects of machnical injuries on viability. In Viability of Seeds. Ed. E.H. Roberts. pp: 94-113. Charpman & Hall, London.
- Standway, V.M. (1977). Evaluation of Forrest Soybeans with Damaged Seedcoats. Preprint 55, 18th ISTA Congress, Madrid.
- Toole, E.H. (1950). Relation of seed processing and condition during storage on seed germination. Proc. Int. Seed Tech Ass. 16 (3) : 214-224.
-