DEPARTMENT OF AGRICULTURE AND FISHERIES, SOUTH AUSTRALIA

Agronomy Branch Report

HARVESTING METHODS FOR SEEDMASTER PHALARIS SEED CROPS

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Introduction

Obtaining maximum yield and quality of Phalaris seed continues to be a problem for the seed grower due to the ease with which seed is shed from the seedhead. With the development of the lesser seed shattering cultivar "Siro Seedmaster" in the 1960's, the task of seed production became easier. Despite this innovation, losses of potential seed yield and seed quality still frequently arise.

Mature seed of the "Siro Seedmaster" cultivar is readily shed from the seedhead during hot, dry, windy weather. As these conditions often occur during the seed maturation period from the end of December to mid-January in South Australia, the seed production of this cultivar is still subject to significant losses.

Potential expansion of seed production of"Siro Seedmaster" phalaris has been suppressed to a large degree by the area which can be harvested safely by each grower. Most seed crops have been harvested as a standing crop in S.A. This necessitates drying the harvested seed from about 20% moisture content to a safe storage moisture of 9-9½%. Drying is usually undertaken on hessian in shearing sheds and the like, and is demanding of both labour and time. Only a relatively small quantity of seed can be successfully handled by individual growers by this method. It is also imperative that the seed is dried quickly after harvest, or it will readily heat up and deteriorate in quality. Phalaris seed is particularly sensitive to loss of viability by high moisture deterioration.

Until recently windrowing of the tall standing crop was not considered a practical method to minimize shattering losses and reduce seed moisture before harvest. However, modifications to the front of self-propelled windrowers have become available from the U.S.A. The attachment of a bar to the front of the machine to push the crop forward before cutting and swathing, means that the machine can make a tight windrow suitable for pickup by conventional seed production harvesters.

The aim of the experiments described in this report, was a commercial test on the feasibility of the new windrowing method for preharvest management of a "Siro Seedmaster" phalaris seedcrop. Seed yield, seed moisture content, and seed germination were compared in three systems of harvest management in 1975-76 and in two systems in 1976-77.

Methods and Materials:

An irrigated crop of *Phalaris tuberosa* (syn. *P. stenaptera*) cv. Siro Seedmaster, sown in May 1974 was used for both experiments. The site was located 10 km north of Naracoorte S.A. in Section 433, Hundred of Jessie, County Robe.

The soil was a solodized solonetz with a sandy loam A horison overlying a clay B horizon. Mean annual rainfall was about 520 mm.

Harvesting treatments in 1975-76 were -

(1) direct heading of the standing crop,

(2) normal windrowing (seed heads taken into the swath first) and

(3) the new windrowing method (stalks taken into the swath first).

Windrowing was done early in the morning to minimize seed shattering four days before harvest (28/12/75) when the average head mosture content of the crop was 31%. Previous research had shown that maximum seed yields were obtained if the crop is harvested when head moisture content was 28-30%.

In the new windrowing method a bar was fitted to the front of the machine so that the crop was pushed forward before cutting with the cutter bar. The location of the attachment of the bar is shown in Appendix Figure 1. The cut material was then drawn onto the canvasses by the reel with the bottom of the stems first. The windrowing machine used was a 3.7 m cut self-propelled John Deere.

Three replicates of each harvest method were set out in successive irrigation bays as plots 5 rows, 61 cm apart in width and 457 m long.

The plots were harvested on 1/1/76 when the standing crop was judged to be at the maturity stage for normal direct heading. The harvester was a "Case" 1060 auto header. A reel front was used for the standing plots and a Draper pickup for the windrowed plots.

All seed was collected on a canvas slung under the horizontally placed Hannaford rotary screen in the seed collection bin. Seed samples were taken from the bulk at three times during the harvest of each plot (near the ends and in the centre).

Plot yield was determined from the bulk of the seed, and seed moisture content, seed germination and purity from the sample.

Harvesting treatments for the 1976-77 experiment were direct heading and the new windrowing method only. Plot sizes and replication, and general harvest procedure were as in the 1975-76 experiment. Plots were harvested on 13th January 1977, windrowing having been done 4 days previously.

Results:

Windrowing the phalaris crop prior to harvest in 1975-76 gave higher pure germinable seed yield than direct heading on a comparable moisture content basis, (Table 1). No statistically significant difference in yield could be detected between the two windrowing techniques used in 1975-76. A standard moisture content of 9% (wet weight basis) was used. Other current research on storage of seeds in S.A. has shown that this is the upper level for safe storage of phalaris seed.

Moisture content of the seed from the direct headed plots in 1975-76 varied between 12.8% and 17.1%. Seed of this level of moisture will not store safely hence drying was necessary to minimise deterioration.

In contrast, seed from windrowed plots varied in moisture content only between 7.3% and 8.3%, and the bulk seed was sent straight to the seed cleaner.

Statistically significant differences in seed germination and purity were found between seed harvested from windrowed and direct headed plots but not between windrowing treatments.

In all parameters studied windrowing prior to harvest gave superior results over direct heading the crop.

In the 1976-77 experiment differences in yield between the two methods failed to reach statistical significance at the 5% significance level (Table 2).

However the general trend was in favour of the windrowing treatment over all three replicates.

Seed moisture content at harvest was significantly higher for the direct headed plots, a result consistent with the results of the 1975-76 experiment. Seed sample purity and final seed germination were significantly lower in the windrowed plots contrary to the previous year's results.

The environmental conditions prior to harvest and during the day of harvest are shown in Appendix Tables 1 and 2.

Discussion:

The use of the improved windrowing method prior to harvest has shown on a commercial size experiment to give superior results in the harvest of "Siro Seedmaster" phalaris when compared to the direct heading method. While this new management tool adds a further operation to the harvest process at a busy time of the year, several advantages may be accrued from its use.

1. Risk of crop loss is minimized. Previous research indicates that maximum viable seed yield of the standing crop is reached at 28-30% head moisture content. Seed is lost from the seedheads at a general rate of about 6% per day and moisture content is lost at 2% per day. Hot, dry windy weather may increase seed loss to 25-50% per day if such conditions occur when the crop is mature enough for direct heading (12-20% seed moisture content).

Many examples of significant seed loss at harvest due to adverse weather conditions are known. Even under ideal weather conditions, 20-30% of the crop is lost in waiting for seed moisture to drop to a level where direct harvesting is practical. A survey of seed moisture content at harvest carried out in the 1973-4 harvest season showed that thirteen Siro Seedmaster phalaris seed crops in the South-East of the state were direct headed when seed moisture was from 22.1 to 11.7% (mean 16.3%).

The seed that is lost is the heavier, higher germination fraction of the seed sample. This loss is of double importance as phalaris seed germinations are generally lower than those of other perennial grasses grown in southern Australia.

While it is possible that a windrowed crop may be at risk from rainy weather the risk of seed loss or deterioration in the windrow is considered to be slight.

General commercial adoption of the new windrowing practice at the 1976-77 harvest has shown that drying of the seed in the windrow is quite rapid (2-4 days) hence the weather can be reasonably predicted and adverse conditions for the windrowing and pickup operations avoided. Seed losses during windrowing have been small provided the operation is carried out during the early morning. Seed retention in the seedhead is favoured by high humidity and low temperature and these conditions generally occur in the early morning.

Risk of deterioration of seed quality in storage is minimized by windrowing. Seed may not maintain its initial germinability if stored over 9½% seed moisture, with progressively rapid deterioration occurring as the seed moisture rises. Deteriorated seed may still be saleable but usually with difficulty and at lower price.

2. <u>Windrowing has economic advantages over direct heading</u>. The cost of windrowing is $16-20/ha. The yield advantage of windrowing over direct heading in 1975-76 of 153 kg/ha at a current seed return to the grower of $1.10/kg would give a nett profit of approx. $120/ha, allowing for slower harvesting of the windrowed crop. However, the grower must consider the purchase or hire of a windrower. Professional growers of perennial grass seed crops could spread the cost of a windrower purchase over several crops. Catch-croppers would probably have to rely on contractors.

As the seed of a windrowed crop is sufficiently dry to transport directly to the seed cleaners without risk of seed deterioration in storage, labour costs are saved during a busy period of the year. Seed from direct headed crops must be dried by one of several methods, all of which increase the cost of production.

3. <u>Windrowing may increase seed quality</u>. While seed germination differences of seed between windrowed and direct headed plots are conflicting between the two years it is most likely that seed quality will generally be better in the former than the latter harvest method. On windrowing more of the heavier seed is retained in the crop and the seed population at threshing is not as susceptible to mechanical damage due to a larger number of immature seed.

Green seeds of very high moisture content (30-40%) are present in the sample from direct heading. These seeds deteriorate rapidly in storage before the bulk of the seed is reduced to safe storage moisture content and so tend to contribute to the dead seed fraction on germination test.

It is unlikely that seed sample purity is a significant factor determining the relative merits of either harvest method. While we did observe that actual harvest of the crop was slower for the windrowed material due to the greater bulk of material having to pass through the header, the purity of the sample is primarily determined by the operator's skill in setting the machine. Sample purity did differ between the two methods in both years but little attention was paid to setting the machine to harvest both treatments with equal efficiency. In all cases sample purity was high.

A number of other phalaris cultivars are at present being grown for seed production. Each of these cultivars are subject to the same harvest problems as "Siro Seedmaster." The moisture contents at which windrowing should occur is also known for these cultivars therefore the new windrowing technique for harvest could also be directly applicable.

Recommendations:

We recommend that seedgrowers of "Siro Seedmaster" and other cultivars of phalaris use the new method of windrowing at harvest. We believe the use of this method will decrease seed handling operations, significantly cut risk of crop loss, increase seed yield and quality, and increase overall production efficiency and profitability.

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TABLE 1. Yield, moisture content, germination and purity of seed of a "Siro Seedmaster" phalaris seed crop harvested by three methods - 1975-76.

Harvesting Method	Pure germinable seed yields (kg/ha) at 9% M.C.	Seed moisture content (%)	Germination (%)		Purity (%)
			7 day	21 day	
Direct heading	497.3	15.4	72.3	82.7	97.7
Windrowing (heads first)	600.7	7.6	84.8	89.3	98.7
Windrowing (stems first)	650.1	7.6	85.9	91.2	98.6
Significant difference level	*	***	**	**	**
L.S.D. 5%	95.6		6.0	4.2	0.5
1%	-		9.1	6.4	0.8

TABLE 2. Yield, moisture content, germination and purity of seed of a 'Siro Seedmaster' phalaris seed crop harvested by two methods - 1976-77.

Harvesting Method	Pure germinable seed yields (kg/ha) at 9% M.C.	Seed moisture content (%)	Germination (%)		Purity (%)
			7 day	21 day	
Direct heading	391.9	15.1	67.2	81.2	98.2
Windrowing	487.8	7.1	58.3	75.8	91.9
Significant difference level	N.S.	***	N.S.	*	**

APPENDIX TABLE 1.

Meteorological Conditions at Naracoorte, S.A., December-January 1975-76 and 1976-77 (from Bureau of Meteorology Records).

	1975-6					1976-77				
Date	Cloud	Wind	Max T	Min T	Rain	Cloud	Wind	Max T	Min T	Rain
15 Dec.	8	0	22	17						
16	5	0	24	11						
17	5	9	26	10						
18	8	4	19	10	1					
19	0	0	19	4	3					
20	8	9	27	7						
21	0	3	22	8						
22	0	0	25	8						
23	0	9	26	9						
24	0	4	25	9						
25	0	4	25	9	9	0	0	24	10	
26	0	24	34	18		8	37	26	15	
27	2	9	36	20		8	9	20	11	
28	6	4	33	18		6	9	20	12	
29	6	21	28	18		8	0	25	14	0.2
30	4	0	26	10		0	9	24	11	
31	0	0	25	9		6	37	39	18	
1 Jan.	3	0	30	10		8	19	39	15	2
2						8	4	22	8	
3						0	4	21	6	
4						2	4	25	11	
5						0	4	29	10	
6						0	4	32	11	
7						0	0	36	15	
8						0	0	35	13	
9						0	4	34	14	
10						8	9	39	14	
11						0	19	25	9	
12						0	4	27	10	
13						8	9	37	11	

<u>cloud</u> in 1/8 cover at 0900

<u>wind</u> in km/hr at 0900

<u>Max T</u> in degrees C

<u>Min T</u> in degrees C

Rain in mm

APPENDIX TABLE 2.

Meteorological conditions at the experimental site during the day of harvest, January 1, 1976 and January 13, 1977.

January 1, 1976

Time (hours)	Temperature (^{o}C)	Relative Humidity (%)
1600	31.0	34
1700	28.3	45
1800	25.6	49
1900	23.9	51
2000	20.6	59

January 13, 1977

Time (hours)	Temperature (^{o}C)	Relative Humidity (%)
1701	32.2	19
1730	34.4	20
1800	29.4	30
1830	27.2	38
1900	26.7	44

Diagram of the bars attached to the front of the John Deere, Model 830 windrower used in the experiments. The framework was constructed of 3.1 cm galvanized water piping.