IMPROVEMENT OF SEED YIELD OF SIRATRO (*MACROPTILIUM ATROPURPUREUM*)

2. RECOVERY OF FALLEN SEED BY SUCTION HARVESTER

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ABSTRACT

The development and monitoring of a method of recovery of a proportion of the pool of shed seed of specialized seed crops of siratro in north Queensland is described.

Horwood Bagshaw Clover Harvesters with pneumatic pick-up of fallen seed, operating in previously header harvested and closely slashed crops, have been used to recover up to c. 350 *kg ha*$^{-1}$ *of high quality cleaned seed from pools of up to* c. 900 *kg ha*$^{-1}$ *of available fallen seed. Methods of handling and cleaning have been developed such that, in spite of the major cost factor of slow ground cover* (c. 0.05 *ha h*$^{-1}$), *suction harvesting as an adjunct to direct heading has become an established and economically viable component of siratro seed crop management.*

INTRODUCTION

A preceding paper (Hopkinson and Loch, 1973) reports the commonplace accumulation of large quantities of shattered seed beneath the canopies of siratro seed crops in north Queensland. We now relate the progress made in the commercial exploitation of this formerly wasted seed.

The background to specialized seed production of siratro is described in the earlier paper. Conventionally, it has relied on the header harvesting of between one and four flushes of seed produced annually during the dry season. When in 1970 measurements began to indicate the magnitude of the pool of fallen seed, however, one of us (C.P.V.) acquired a suction harvester and began the development of a system for its recovery. In 1971 a second machine was bought locally, and by 1972 seven were operating in the district, recovering an estimated 20,000 kg of seed. The region of operation is the major siratro seed producing district of the state—the lower Atherton Tableland (lat. 17°S, long. 145°E; elevation 400-600 m; annual average rainfall *c.* 900 mm, predominantly summer wet season; soils irrigable).

HARVESTING PROCEDURE

The techniques developed between 1970 and 1973 for the suction harvesting of siratro seed are summarized below.

Land preparation

Most crops were originally planted without thought of suction harvesting. Experience has since emphasized the importance of a compact, level soil surface. Imperfections in the soil surface, whether in the form of unevenness, looseness, or the presence of obstructions (stones, etc.) greatly reduce the efficiency of recovery.

Preparation immediately before suction harvest involves the close slashing of remaining vegetation (the crop having normally been recently header harvested), and the side-raking of material thus detached into windrows. Such preparation precedes harvest by no more than a few days, as deterioration of exposed seed is believed to be rapid. Excessive proportions of split seed have been observed after

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too long an interval, a condition reasonably attributable to prolonged exposure to direct sunlight.

Harvest machinery

Horwood Bagshaw Clover Harvesters are the only type of machine in use, and are all fitted with the optional high-capacity pick-up duct (1.2 m width). These are tractor drawn and powered machines requiring a minimum of 37 kW power at the P.T.O. Material is picked up and conveyed pneumatically to a conventional threshing and separating assembly.

Harvest operation

Naked siratro seed, being smooth and dense, is less well suited to pneumatic recovery than are the podded seeds for which the harvester was designed. Low ground speed (of the order of 0.8 km h^{-1}) and maximum vacuum at the mouth of the pick-up duct (specified as 4.3 cm of water under recommended conditions) are necessary. These conditions lead to the intake of an excess of soil particles, especially on soils of good crumb structure, which are apt to over-tax both the harvester's cleaning capacity and (unless power at the P.T.O. greatly exceeds the specified minimum) the tractor's P.T.O. performance.

These problems are overcome by appropriate land preparation, by use of only half the width of the duct, and by correct choice of screens and machine settings. Very slow travel is inevitable, however, and 0.05 ha h^{-1} appears to be about the limit for satisfactory operation.

Seed processing

The drying of suction harvested seed is unnecessary, and its handling and storage presents little trouble provided the dirt content is not unduly high. Given suitable rotary screens (about 1.6 × 15 mm slot perforations) the inert matter content ought not to exceed 50 per cent by weight in the harvested bulk.

Cleaning has until recently been a major problem, the complete separation of dirt particles and seed being impossible with conventional cleaning machinery. The adoption of a flotation method using a high density fluid, perchlorethylene, as a final cleaning operation has overcome the problem. Originally performed manually, the method has recently been mechanized with the design and construction of a flotation cleaner by Mr. I. Grevis-James (Q.D.P.I., Toowoomba).

TABLE 1

Quantities of seed recorded (kg ha^{-1}) with S.E. of means in crops suction harvested

Reference	Harvest date	Seed present Before* harvest	Seed present After harvest	Estimated harvest yield	Number of prior header harvests in that season	Yield of preceding header harvest
A	xii.70	680±57	195±72	195	2	206
B	ix.70	736±88	173±61	190	2	perhaps 100
C	x.71	728±54	—	260	2	perhaps 100
D	ix.72	872±100	390±65 }	*c.* 300	0	—
E	x.72	913±35	183±29 }			
F	xi.72	551±53	173±53	*c.* 350	1	*c.* 300
G	xii.72	554±54	—	*c.* 150	1	perhaps 100
H	xii.72	686±63	—	*c.* 220	1	perhaps 150

*Comprises seed present in header debris, stubble, litter, and on ground.

CROP MEASUREMENTS

Methods

Commercial crops were sampled as the opportunity arose. Usually ten 0.4 m^2 randomly located quadrat samples were taken per crop. Seed was separated from the cut and swept sample of vegetation and soil by conventional cleaning methods followed by flotation on perchlorethylene (S.G. = 1.6). Quantities of fallen seed were estimated from the quadrat yields. Machine harvest yield estimates were supplied by the growers.

The first crop to be suction harvested (crop A, Table 1) was the one in which the 1970 experiment (see Hopkinson and Loch 1973 for details) was located. The data on seed quality (Table 2) also came from this crop.

Results

The harvest operation in crop A (Table 1) was protracted owing to inexperience and bad weather, but yielded substantially by contemporary standards of header harvesting. It nevertheless represented less than 30 per cent recovery of the quantity present when suctioning began. About a further 30 per cent remained intact in the paddock at the end of the harvest. Losses due to germination and death on the ground, damage during harvesting, and imperfect cleaning presumably accounted for the balance.

The quality of machine harvested seed, like that of hand harvested fallen seed, was high (Table 2). Suction harvested seed had a reduced hard seed content, presumably due to scarification during passage through the machine. The seed remaining on the ground after harvest showed the same reduction in hard seed. Possibly much of this seed had passed through the harvester. Equally possibly, exposure to the elements after removal of the protective cover of vegetation and litter had softened the seed.

TABLE 2

1970 experiment. Seed quality of fallen and suction harvested seed

Origin of seed	Percentage of seed			Mean single seed weight (mg)
	Germinating	Hard	Total live	
Hand harvested before suction (20.xi.70)	31	59	90	13.1
Hand harvested after suction (8.xii.70)	66	28	94	12.8
Suction harvested (20.xi.-8.xii.70)	66	29	95	13.5

Subsequent germination tests on suction harvested seed have, in our experience, invariably indicated high quality.

The combination of required revolutions and torque at P.T.O. with low ground speed proved difficult to obtain with available tractors, and contributed to the low efficiency of recovery recorded in 1970 and 1971. In general, tractors of about 45 kW brake power have been used, but have been inadequate in all but the easiest conditions. The high yield of crop F was obtained with the use of a tractor rated at about 60 kW—a figure now locally accepted as the minimum for efficient performance in all conditions.

The experience gained in previous years was used to advantage in 1972, particularly to improve the efficiency of recovery. Though subsequent cleaning losses remained considerable, seed removed from the paddock in three 1972 crops (P, E and F) was estimated to represent 55, 80 and 69 per cent of the total present.

Crop F was remarkable in yielding, with header and suction harvests combined, a total of about 650 kg ha^{-1}. The crop being in its first season, there was no possibility of fallen seed being derived from previous years' crops. An estimate of the total amount of seed present before harvest of the standing crop was 1,150 kg ha^{-1}.

DISCUSSION

The very early start to the wet season in 1973 seriously restricted the suction harvest. Progress was made primarily in the initial separation of seed and dirt in the paddock, and in the subsequent handling. With expertise and suitable machinery, it is possible to bring in seed from the paddock with less than a 40 per cent dirt content and clean it in three operations—once each through a wind and screen cleaner, a gravity table, and a flotation cleaner.

Overall handling and cleaning costs have thus been reduced to tolerable levels, only marginally higher than those of handling header harvested seeds. The dominant and inevitable production cost is that arising from slow harvesting—one hectare occupies a man, a tractor, and a harvester for a minimum of two working days.

Evidence recorded in the earlier paper indicates a pool of available seed of between about 500 and 1,000 kg ha^{-1} as a reasonable expectation. The maximum recorded recovery of cleaned seed so far is about 350 kg ha^{-1}, but this is obviously well below the realistic potential.

The crops listed in Table 1 represent a reasonable cross-section of irrigable crops managed by experienced growers, and could have been expected to yield 200 to 300 kg ha^{-1} annually from header harvesting (c.f. annual north Queensland average of *c.* 150 kg ha^{-1} for all siratro crops). The suction harvest yields thus substantially increased yield per unit area. In spite of high recovery costs the extra seed obtained by suction harvesting enables the high per unit area production costs to be spread over a far greater quantity of seed, and so will probably assure a long term future for pneumatic recovery.

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REFERENCE

HOPKINSON, J. M. and LOCH, D. S. (1973)—Improvement in seed yield of siratro (*Macroptilium atropurpureum*). 1. Production and loss of seed in the crop. *Tropical Grasslands* 7: 255-268.

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