Field validation of drudgery-reducing spiral grain separator

RAJESHWARI DESAI and PRIYA SAJJAN*

Main Agricultural Research Station
***Department of Family Resource Management**
University of Agricultural Sciences, Dharwad 580005 Karnataka, India
Email for correspondence: rajmanohardesaiuas@gmail.com

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ABSTRACT

Spiral grain separator, a manually-operated machine is cost-effective that requires minimum maintenance. All round-shaped grains like green gram, black gram, soybean, Bengal gram etc can be cleaned and graded at the range of 15-30 minutes per quintal with this machine. Being time- and labour-saving and drudgery-reducing farm implement it can be of best use to the farmers.

Keywords: Field validation; drudgery; spiral grain separator

INTRODUCTION

Agriculture is the backbone of Indian Economy. Agriculture is basically an energy conversion industry. A farm is an energy consumer and a producer because with the use of the different energy inputs, energy output as a crop production is available. India has a major agribusiness sector which has achieved remarkable successes over the last three and a half decades. Unprocessed foods are susceptible to spoilage by biochemical processes, microbial attack and infestation. The right postharvest practices such as food processing techniques play a significant role in reducing spoilage and extending shelf-life. Separation removes unwanted materials like straws, chaff, weed seeds, soil particles and rubbish from the grain. It improves grain stability, reduces dockage during milling, gives good quality milled material and improves the milling output. It also reduces insect pest and disease infestation. Removing dockage from grain is a common handling practice; food processing requires clean grains to ensure purity.

Separation of grain for seed also requires considerable cleaning to ensure the highest quality seed (Patil and Bansod 2014). The separator classifies seed according to its shape and rolling ability. Spiral separators are commonly used to separate good seeds from splits, weed seeds, chaff, hulls, stems etc and can be used to separate one kind of seed from another depending on their shape and size. It can be used to clean round-shaped seeds/grains viz soybean, green gram, black gram, Bengal gram, corn, mustard, peas, wheat, coriander, millets, peppercorn and much more (Nagesh and Lakshminarasimhan 2014).

Operating by gravity the separator contains a spiral (or spirals) that is fed from a top hopper with an adjustable feed plate. The seeds leaving the hopper run over a cone divider which spreads them evenly onto the inner flights. As material flows down the flights the round seeds travel at a much faster speed than the non-round material. Their momentum increases until the round seeds run over the edge of the inner flights, drop into the outer flight and discharge through a spout at the bottom of the separator. The non-round materials remain on the small inner flights and slide down to a separate discharge spout at the bottom. It consists of sheet metal strips fitted around a central axis in the form of a spiral. The unit resembles an open screw conveyor standing in a vertical position. The seeds are introduced at the top of the inner spiral. Round seeds roll faster down the incline than flat or irregularly-shaped seeds which tend to slide or tumble. The orbit of round seed increases with speed on its flight around the axis until it rolls over the edge of the inner flight into the

outer flight where it is collected separately. The slower moving seed does not build up enough speed to escape from the inner flight. Most spirals have multiple inner flights arranged one above the other to increase the capacity.

Determining the correct spiral separator to be used depends on the diameter, shape and weight of the material being separated. There is no single size spiral that will separate all types of materials. The degree of pitch and diameter of the inner flights on a spiral determine the quality of separation. In some applications different types of materials that have similar size and weight may be separated on the same spiral but the quality of separation may vary.

Eco-friendly process: Since there are no moving parts no power is required to operate the separator. Once the feed has been properly set the separator continues to operate automatically as long as there is seed in the hopper.

Long-lasting durability: The heavy-duty construction manufactured with welded galvanized steel helps to withstand heat and vibration.

Thorough separation: It is with (up to) four separating turns to ensure effectiveness.

The field validation of improved agricultural labour-saving and cost-effective tool spiral grain separator was the general objective of the study.

Agricultural technology is so advanced these days that it is hard to assume how people cooped with the laborious and time-consuming grain cleaning process in the past. The important spiral grain separator is that it takes each of the hard work out from the equation. It processes a great deal of grain/seed every hour leaving farmer free to get on with other and also reduce the drudgery.

The present investigations were conducted with the objectives to study the existing methods of performing grain cleaning activity by farmers/women through PRA technique, carry out field validation of spiral grain separator, to compare its performance with existing methods and to assess its acceptability by the farmers.

METHODOLOGY

A sample of 60 farm families was selected from some villages of Dharwad Taluk for the study. The information on existing methods of performing grain cleaning activity by farmers/women was collected through PRA technique and a self-structured questionnaire. The acceptability of spiral grain separator by the farmers was collected by using five point scale. The parameters viz number of labourers, time and electricity required were studied to compare the performance of spiral grain separator with existing methods. Further the efficiency of the separator was tested with respect to different types of grains/seeds.

RESULTS and DISCUSSION

Socio-demographic characteristics of the selected farmers: The socio-demographic characteristics of the selected farmers are presented in Table 1. It is clear from the data that more than half of them (56.70%) were in the middle age group of 36-50 years followed by old (36.70%) and young (6.70%). One third of them (33.30%) had studied up to degree level followed by high school (25%) and meager percentage of them were illiterates (3.30%). Majority of the respondents belonged to medium size families (73.30%) followed by large (15%) and small (11.7 %). About half of the respondents (51.70%) had large landholdings followed by medium (35%). Majority of them had an annual income of more than Rs 20000 .

Existing methods of cleaning/grading of grains/ seeds: The survey on existing methods of cleaning/ grading of grains/seeds revealed that both winnowing and machines were used to clean the grains at the farms by majority of the farmers (41.70%) followed by only machine (23.30%) and winnowing (26.70%). Sieves were used to clean the grains at household level (Table 2). The respondents opined that they needed approximately 3-7 hour to clean one quintal of grain manually.

Majority of the respondents were not cleaning/ grading the grains before marketing. The main reasons expressed by the respondents for not cleaning the grains/seeds before marketing were that it was costly and involved drudgery (32.35%), it was a wastage of time and costly affair (20.59%) and it was not possible due to shortage of labour and involved drudgery (14.70%) (Table 3).

Table 1. Socio-demographic characteristics of the selected farmers (n= 60)

Characteristic	Frequency	Percentage
Age (years)		
Young (18-35)	04	06.70
Middle (36-50)	34	56.70
Old (51 and above)	22	36.70
Education		
Illiterate (0)	02	03.30
Primary school (1^{st} – 4^{th} standard)	01	01.70
Middle school (5^{th} – 7^{th} standard)	09	15.00
High school (8^{th} – 10^{th} standard)	15	25.00
PUC (11^{th} – 12^{th} standard)	13	21.70
Degree (>12^{th} standard)	20	33.30
Family size (number of family members)		
Small (1-4)	07	11.70
Medium (5-8)	44	73.30
Large (9 and above)	09	15.00
Landholding (acres)		
Marginal (up to 2.5)	01	01.70
Small (2.5 – 5.00)	07	11.70
Medium (5 – 10)	21	35.00
Large (>10)	31	51.70
Annual income (Rs)		
Below poverty level (up to 20000)	12	20.00
Above poverty level (>20000)	48	80.00

Table 2. Existing methods of cleaning/grading of grain (n= 60)

Particulars	Frequency	Percentage
Grain cleaning method at farm		
Winnowing	14	23.30
Harvesting machine	16	26.70
Both the above	25	41.70
Any other	05	08.30
Tools/equipment used to clean grain		
Sieve	19	31.70
Mara	05	08.30

Table 3. Reasons perceived by the respondents for not cleaning/grading the seed before marketing (n= 60)

Reason	Frequency	Percentage
Wastage of time	01	02.94
Wastage of time and costly	07	20.59
Wastage of time and shortage of labour	02	05.88
Costly	02	05.88
Costly and shortage of labour	01	02.94
Costly and involvement of drudgery	11	32.35
Shortage of labour and involvement of drudgery	05	14.70
Involvement of drudgery	02	05.88
Involvement of drudgery and shortage of labour	01	02.94
Any other	02	05.88

Field validation of spiral grain separator: Averages of different parameters of seed cleaning/grading in spiral grain separator are shown in Table 4. The observations showed that the average time taken to clean one quintal soybean in spiral grain separator was only 15 minutes with two labourers. This was probably because of the round shape and smooth surface of soya grains. To clean black gram and green gram the average time taken was 16 and 17 minutes respectively as the grains are not exactly round in shape. The grains had to be put into the machine 3-4 times to clean them completely. It took nearly half an hour (28.08 minutes) to clean Bengal gram as the grain does not have smooth surface. These results are on par with the results of Dahimiwal et al (2017) who observed that grain grading and polishing machine reduced time required for grading and remove dust, contaminations, impurities and hauling from grains. The spiral grain separator was not found suitable to clean wheat because of its oblong shape. Hence the inference can be drawn that the machine is best suited to clean round-shaped and smooth-surface grain.

Comparison of spiral grain separator with other methods: Three methods of grain cleaning methods were compared with the parameters viz time, labour and electricity required (Table 5). The results showed that spiral grain separator was the best as compared to other two methods as on an average 3.5 q of grains/ seeds were cleaned per hour with two laborers and without electricity. In seed cleaning machine large quantities of seeds can be cleaned in lesser time (400 q/hour) but it required electricity. Manual grain cleaning method was laborious, tedious and time consuming (0.2 q/hour). Thus it was inferred that use of spiral grain separator reduces the labour and saves time while cleaning and grading the seed/grain. These findings are in agreement with the results of Borkar et al (2016).

Accessibility of the spiral grain separator to the selected respondents: The accessibility of the spiral grain separator was assessed by using five point scale (agree to disagree). The respondents who had undergone the training were selected to study the accessibility of the tool. All the respondents opined that the tool was light in weight and was drudgery reducing and time and labour saving device. Only one fifth of the sample opined that the tool was durable whereas 24 per cent of the respondents did not agree to it. Majority of them felt that the tool was inconvenient to use as it was too tall. The respondents agreed with the statement that the tool was costly to purchase. All the respondents opined that the major disadvantages of the tool were that it could be used to clean only round

Table 4a. Time and labour involved in seed cleaning/grading of different crops in spiral grain separator

Seed	Quantity (q)	Time (minutes)	Labour involved (number)
Soybean	1	15:00	02
Green gram	1	17:00	02
Black gram	1	16:00	02
Bengal gram	1	28:08	02
Wheat*	-	-	-

*Not suitable

Table 4b. F-test for time factor between existing method of grain cleaning and spiral grain separator (1 q)

Seed	Labour (number)	Time (minutes)	
		Existing method	Spiral grain separator
Soybean	02	246	15:00
Green gram	02	215	17:00
Black gram	02	220	16:00
Bengal gram	02	182	28:08

F-value
Treatments= 14.30**
Replications= 1.04^{NS}

Table 5. Comparative efficiency of different methods of seed cleaning

Parameter	Existing method (manual)	Seed cleaning machine	Spiral grain separator
Time (q/h)	0.20	400	3.5
Labour (number)	02	02	02
Electricity	Not required	Required	Not required

Table 6. Acceptability of the spiral grain separator by the selected farmers (n= 50)

Parameter	Agree	Partially agree	Neutral	Partially disagree	disagree
Light in weight	12 (24.00)	38 (76.00)	- Durable	-	-
	-	10 (20.00)	28 (54.00)	12 (24.00)	-
Drudgery-reducing	14	36 (28.00)	- (72.00)	-	-
Only round-shaped grains can be cleaned	50 (100)	-	-	-	-
Time saving	32 (64.00)	28 (56.00)	-	-	-
Noise pollution	50 (100)	-	-	-	-
Costly and lengthy process to purchase	13 (26.00)	37 (74.00)	-	-	-
Labour saving	05 (10.00)	27 (54.00)	18 (36.00)	-	-
Inconvenient to use	-	32 (64.00)	18 (36.00)	-	-
Adoption of the tools	04 (8.00)	16 (32.00)	07 (14.00)	06 (12.00)	17 (34.00)

Figures in the parentheses indicate percentage values

shape grains and it made noise while cleaning the grains (Table 6).

CONCLUSION

It was concluded from the study that spiral grain separator is a cost-effective and labour-, time- and drudgery-reducing farm tool. Hence there is a great scope for its use in agriculture which can result in improved economy of the farm families.

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