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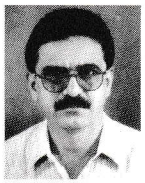
Performance Evaluation of Planters for Cotton Crop



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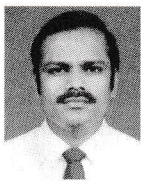

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Abstract

The seedbed and planting operations consume nearly 20% of the energy required from sowing to marketing and hence the choice of type of implement for seed bed preparation and sowing determines the economics of cotton cultivation. The available models of planters which can be used for cotton planting are tractor-drawn ridger seeder, tractor drawn pneumatic precision planter and tractor-cultivator mounted seeder. The above three implements were evaluated for their performance in cotton crop production. The standard deviation, coefficient of variation and deviation from the recommended depth were low in ridger seeder when compared to other seeders. Thus more uniform depth of seed placement was obtained with the ridger seeder. The planting operation with ridger seeder, pneumatic planter and cultivator seeder resulted in 44.00, 42.85 and 41.64% saving in cost, respectively, when compared to conventional method. Among the three implements, the savings in cost was high in the ridger seeder treatment. There was a savings of 96.4, 96.3 and 96.2% in time by the ridger seeder, pneumatic planter and cultivator seeder, respectively, when compared to manual sowing.

Introduction

Rational methods of tillage are directed at creating optimal conditions for plant growth and development at which the soil prepared for sowing has the necessary soil conditions for ensuring moisture conservation, good contact of seed with soil, uniform germination, good plant development and high yields. Efficient use of costly inputs by proper and timely operation can be achieved by appropriate adoption of machinery. In the dynamic and fast changing agricultural scenario in the country, particularly diversification in the cropping pattern and commercialization of agriculture more efficient and sophisticated equipment are required by the farmers. The demand for equipment in the country will continue to rise in the coming years. The present situation on migration of labour to various scholastic jobs and thrust more production to feed the increasing population make the cotton farming a tiresome one. This situation necessitates the introduction of machinery for cotton production.

Review of Literature

Singh *et al.* (1985) developed a two-row ridge planter for planting winter maize. The planter formed ridges and metered maize seeds on one side of the ridge. The machine was evaluated in the field over an area of 0.4ha. The average seed-to-seed distance was 0.198m, row-to-row spacing 0.60m and the average ridge height was 0.25m. The capacity of the planter was 0.10ha/hr at a forward speed of 2.5kmph. A tractor-drawn precision planter was designed and developed for the bio-scientists at CIAE, Bhopal. The machine has special provisions of changing the seed varieties and plot length to suit the specific requirements of the bio-scientist in their

Fig.1 Tractor drawn ridger seeder

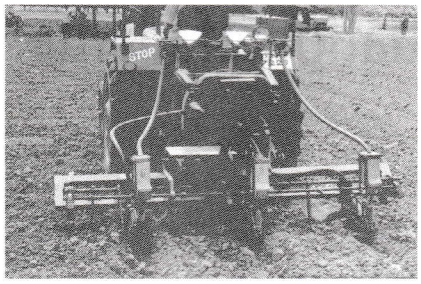

Fig.2 Pneumatic precison planter

experiments. The machine is available in 2, 4 and 6 rows with plot length variations of 3-12m at an interval of 0.5 meter each (Yadav *et al.* 1987). Rodriguez and Soto (1989) developed a machinery that carried out four simultaneous operations, namely; soil loosening, soil leveling, drilling and fertilizer application. The field evaluation of the unit showed that at a forward speed of 4kmph a soil loosening efficiency of 82% was achieved and 214200 plants per ha was satisfactory. Savings of 57, 50 and 40% were attained for total operating cost, fuel and labour, respectively.

Materials and Methods

The available models of planters which can be used for cotton planting are:

Tractor-drawn ridger seeder (TNAU model)

Tractor-drawn pneumatic precision planter (CIAE model)

Tractor cultivator-mounted seeder (TNAU model)

These three implements were selected for the field performance evaluation. Their description and specification are shown below:

Description and specification of the cotton planters

a. Tractor-drawn ridger seeder (TNAU model)

The ridger seeder was designed and developed as a rear-mounted attachment to a four wheel tractor of 35 to 45hp range, commonly available among farmers. The developed unit consisted of a ridge-forming mechanism and a seeder (**Fig.1**) to form ridges and furrows and to seed on one side of the ridges in one pass. The ridges and furrows were formed by a three-bottom ridger. The planter consisted of cup feed-type seed metering mechanism, spiked ground wheel, chain and sprocket drive for transmitting power from ground wheel to the seed-metering shaft and seed placement devices. A dog clutch was provided to engage or disengage the power to the seed metering shaft. Markers were fitted on either side of the unit, so as to mark the next row over which the next pass of the implement has to start. The cost of the unit was Rs.17,500. Its salient features unit were formation of ridges and sowing of the seed simultaneously; an area of 3ha can be covered per day: The results were 24 and 90% savings in cost and time, respectively when compared with the conventional method. The specifications of the unit are shown in **Table 1**.

b. Tractor-drawn pneumatic precision planter (CIAE model)

The exact placement of single seed in the soil ensures savings in costly seeds, reduces the problem of thinning and crop yield was high as each plant got the desired quantity of sunlight, water and nutrients. The existing commercial planters do not meet the requirements of crops. A six-row tractor-drawn pneumatic precision planter was designed and developed at the CIAE, Bhopal, for precise planting of single seeds at predetermined seed/row spacing (**Fig.2**).

The machine worked on suction principles. Air was sucked through a rotating plate with various holes placed radially. Any seed coming in contact got stuck to the holes on the plate and fell immediately when suction was cut off at the lowest position near the ground. The fall of seed was synchronized with the predetermined seed spacing. Thus exact planting of single seed was obtained. Since the seed was lifted under suction, no mechanical seed damage occurred. However, the machine required high quality seeds for better performance. The cost of the implement was Rs.70,000. The specifications of the unit are shown in **Table 2**.

c. Tractor cultivator-mounted seeder (TNAU model)

This tractor-drawn implement was used for line sowing of crops such as cotton, groundnut, sorghum, maize and pulses. The tractor industry in India has grown and has now attained about 2.6 lakh tractors be-

Details	Value
Over all dimensions (LxBxH), mm	2400x1750x1100
Wight, kg	300
Number spacing, mm	3
Row spacing, mm	600-900 (Adjustable)
Plant spacing in rows, mm	150-300 (Adjustable)
Type of seeds used	Delined/coated cotton seeds
Nominal working width, mm	1350-1800 (Adjustable depending on variety of seeds)
Depth of planting, mm	30-50 (Adjustable)
Type of seed metering mechanism	Cup feed
Furrow opener and closer	No separate devices were provided. Mild steel tubes fixed on side of ridger bottom place the seed and soil turne by the ridger wings cover the seed

Table 1 Speciffication of tractor drawn ridger seeder

Details	Value
Over all dimensions (LxBxH), mm	2000x1520x2000
Wight, kg	300
Source of power	30-45hp tractor
Number of rows	2, 4 and 6 (Adjustable)
Type of seeds metering mechanism	Pneumatic suction principle
Plant spacing	Row spacing and seed to seed spacing adjustable as desired
Sprocket train	13 to get desired spacing of 30cm

Table 2 Speciffication of tractor drawn pneumatic precision planter

Details	Value
Over all dimensions (LxBxH), mm	2500x1030x1240
Wight, kg	410
Source of power	35-45hp tractor
Number of rows	3-5
Row spacing, mm	450-900 (Adjustable)
Plant spacing in rows, mm	150-300 (Adjustable)
Type of seeds used	Delined/coated cotton seeds
Nominal working width, mm	1800-2250
Depth of planting, mm	30-50 (Adjustable)
Type of seed metering mechanism	Cup feed
Furrow opener and closer	No cultivator shovels are used to open the furrows and a mild steel square bar is used to cover the seeds placed in the opened furrow

Table 3 Speciffication of tractor drawn cultivator mounted seeder

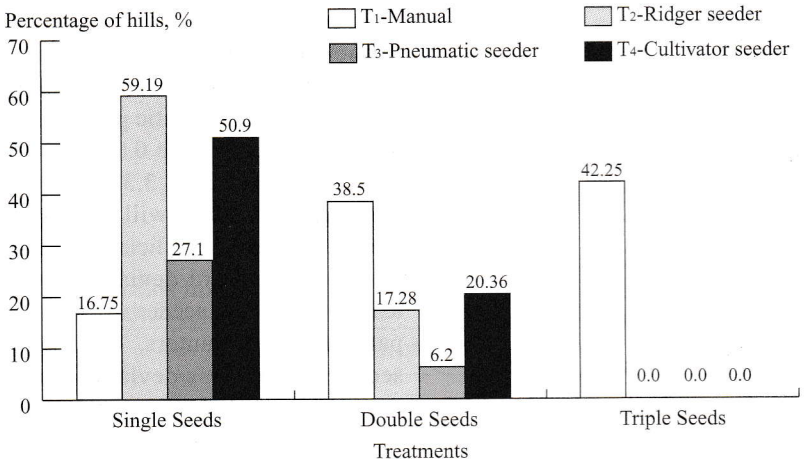

Fig.5 Percentage of hills with single, double and triple seeds

ing manufactured per annum. Even small-and medium-size farmers are hiring tractors for different agricultural operations. Any farmer who owns a tractor invariably has a the tractor-drawn cultivator. Seed boxes along with cup feed type seed metering mechanism are mounted on the cultivator frame and the seeds are dropped in furrows opened by the cultivator shovels (**Fig.3**). Detachable side wings are fixed to the existing shovel type furrow openers of the cultivator which helps in placing the seed at the required depth. The Power to operate the seed metering discs is taken from the ground wheel drive though a clutch. A square bar is provided at the back of the unit to close the furrows. The cost of the implement was Rs.10,000 without the cultivator. The salient features of the unit are: suitable for sowing cotton, groundnut, sorghum, Bengal gram, maize, soybean and pulse which result in 48 and 91% savings in cost and time, respectively; spacing can be adjusted according to the crop; and an area of 4 ha can be covered per day; The specifications of the unit are shown in **Table 3**.

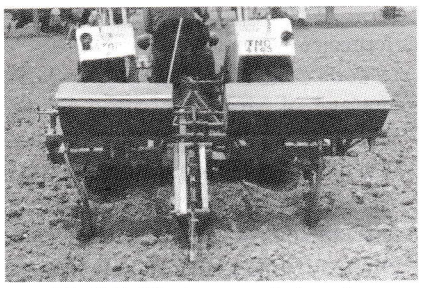

Fig.3 Cultivator mounted seeder

Treatments Selected for The Investigation

All the selected three planters were evaluated for their performance in sowing cotton seed. The treatments selected for the investigation were:

T_1-Control (Tilling with cultivator twice + Ridge forming + manual sowing)

T_2-Tilling with cultivator twice + Ridger seeder

T_3-Tilling with cultivator twice + Sowing with pneumatic precision planter

T_4-Tilling with cultivator twice + Sowing with cultivator-mounted seeder

In the conventional method after the seedbed preparation, women labours were engaged for dibbling the seed on the sides of the ridges (**Fig. 4**). Each treatment was replicated thrice. For all the treatments, seedbed preparation was common. The operations were:

1. Ploughing once with tractor-drawn disk plough.

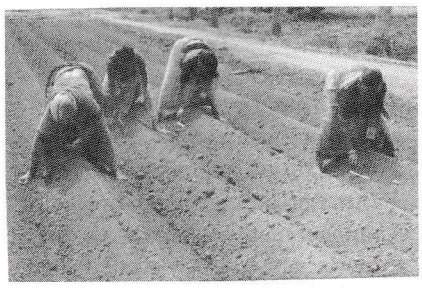

Fig.4 Conventional method

Date of test	14th August 2001
Test condition	
(a) Condition of seed	
Name of seed	Cotton
Variety	MCU 12
Shape of seed	Oblong
Weight of 1000 grains, gm	102.35
(b) Condition of field	
Location	Dept. of cotton, TNAU Campus
Length of field, m (each treatments)	45
Width of field, m	11.25
Area of field, m^2	506.25
Shape of field	Rectangular
Type of soil	Red soil
Texture	Sandy loam
Method of preparation of field (seed planters)	Ploughing once with disc and cultivator twice
For control	Ploughing once with disc, twice with cultivator and ridge forming by tractor drawn ridger
(c) Operational parameters of machine	
Row spacing, mm	750
Plant spacing, mm	300
Depth of seed placement, mm	20-30
(d) Speciffication of power source	
Make and model	Ford Escort
Rated power hp	45
Control plot	Mnual dibbling

Table 4 Field conditions under which performance test was conducted for all the tretments

Partculars	T_1 Manual	T_2 Ridger seeder	T_3 Pneumatic planter	T_4 Cultivators seeder
Actual operating time, min	20.73	7.25	7.85	8.5
Time lost for turning, min		2.63	2.67	2.77
Actual area covered, m^2	506.25	506.25	506.25	506.25
Effective working width, m	0.75	2.25	2.25	2.25
Operating speed, kph		2.92	2.61	2.36
Effective field capacity, ha/hr	250women hrs/ha	0.42	0.387	0.357
Theoretical field capacity, ha/hr		0.657	0.591	0.535
Field efficiency, %		64.0	65.5	66.7
Depth of seed placement, m	28.4	29.7	31.3	29.3
Distance between plants, m (average)	0.3192	0.3059	0.3054	0.3181
Number of plants per hill	2 to 3	1 or 2	1 or 2	1 or 2
Rate of missing hills, %	2.5	23.53	66.70	28.79
Seed rate, kg/ha	14.62	8.7	3.95	4.94
Row to row distance, m	0.75	0.75	0.75	0.75

Table 5 Results of field performance evaluation

2. Ploughing twice with tractor-drawn cultivator.
3. Formation of ridges and furrows by tractor-drawn ridger (for conventional method only).

A germination test was conducted to study the actual germination percentage of MCU 12 cotton seeds, which were used in the field evaluation of the unit. The mean value was 70%. The minimum germination percent for the cotton variety recommended was 65%. The field condition under which performance test was conducted for all the treatments is furnished in **Table 4**.

Results and Discussion

The data observed during the field trails and the results of the performance evaluation of the selected four treatments of investigation are shown in **Table 5**.

The field capacities of the ridger seeder, pneumatic planter and cultivator seeder were 0.42, 0.387 and 0.357 ha/hr and field efficiency were 64, 65.5 and 66.7%, respectively. An analysis of the plant spacing data of the selected four treatments is shown in **Table 6**.

The average spacing between plants sown using the manual dibble, ridger seeder, pneumatic planter and cultivator seeder were 0.319, 0.306, 0.306 and 0.318m respectively which are slightly higher than the recommended spacing of 0.3m in all the cases.

The coefficient of variation and standard deviation in control plot, ridger seeder, pneumatic planter and cultivator seeder were 0.072, 0.109, 0.42, 0.1 and 2.284, 3.334, 35.81, 3.09, respectively. It will be shown that the values of coefficient of variation and standard deviation were less for the ridger seeder when compared to other planters. The ridger seeder showed less deviation from the recommended spacing (3.38%) when compared to the others except the pneumatic planter (1.61%). But the percentage of missing hills was much higher for the pneumatic planter when compared with the others.

The missing hills for the ridger seeder, pneumatic planter and cultivator seeder were 23.53, 66.70 and 28.74%, respectively. But in the control plot the percentage of missing hills was 2.5%. This may be due to the sowing of 2 or more seeds at a time. The number of multiple hills was much higher (80.75%) when compared those of the seed planters.

Partculars	T_1 Manual	T_2 Ridger seeder	T_3 Pneumatic planter	T_4 Cultivators seeder
Number of seedling actions (in 5m length)	15.60	16.20	16.20	79
Average spacing, m	0.319	0.306	0.305	0.318
Deviation form recommended spacing (%)	6.412	3.38	1.10	6.89
Standard variation	2.284	3.334	35.81	3.09
Coefficient of variation	0.072	0.109	0.42	0.10
Number of missing hills	0.40	3.80	10.8	23
Number of hills with one plant	2.60	9.60	4.4	40
Number of hills with two plants	6.00	2.80	1	16
Number of hills with three or more plants	6.60	0	0	0
Missing hills (%)	2.50	23.53	66.7	28.74
Percentage of singles	16.75	59.19	27.1	50.90
Percentage of doubles	38.50	17.28	6.2	20.36
Percentage of triples or more	42.25	0	0	0

Table 6 Results of the analysis of plant spacing date

Sl. No.	T_1 Manual	T_2 Ridger seeder	T_3 Pneumatic planter	T_4 Cultivators seeder
1	2.5	2.9	3.1	2.8
2	3.0	2.8	3.3	2.9
3	2.6	3.1	3.0	2.9
4	3.1	2.9	3.4	3.1
5	2.9	2.8	2.9	2.8
6	2.6	2.8	3.3	2.7
7	2.5	3.0	2.9	3.0
8	3.1	3.0	3.2	3.1
9	3.2	3.2	3.0	2.9
10	2.9	3.2	3.2	3.1
Average	2.84	2.97	3.13	2.93
SD	0.2538	0.1487	0.1676	0.1345
CV	0.0894	0.0501	0.0536	0.0459
Percent deviation from recommended depth	5.30	1.00	4.30	2.33

Table 7 Depth of speed placement

Sl. No.	T_1 Manual	T_2 Ridger seeder	T_3 Pneumatic planter	T_4 Cultivators seeder
Total cost, Rs/ha	4,469	2,503	2,554	2,608
Saving in cost when compared to manual, %	-	44	42.85	41.64
Saving in time when compared to manual, %	-	96.4	96.3	96.2

Table 8 Abstract of appraisal of cost and time

In general, the germination percentage for cotton seeds varied from 65 to 80%. This means that percentage of missing hills using the planters was within the range of germination percentage. The percentage of hills using the single, double and triple plants in all the treatments are shown in **Fig.5**. It will be shown that for the ridger seeder and cultivator seeder, the numbers of single plants per hill were in the range of 50-60%, while in control plot it was only 16.75%. Thus it is evident that the seed planters planted the recommended number of seed in majority of the hills.

The varying depths of seed placements in the selected treatments are indicated in **Table 7**.

The average depths of placement of seed in control plot, ridger seeder, pneumatic planter and cultivator seeder were 2.84, 2.97, 3.13 and 2.93cm, respectively. From **Table 7** the standard deviation, coefficient of variation and deviation from the recommended depth were less for the ridger seeder when compared to the other seeders. Thus more uniform depth of seed placement was obtained with the ridger seeder. The abstract of cost of appraisal is shown in **Table 8**.

The planting operation using the ridger seeder, pneumatic planter and cultivator seeder resulted in 44.00, 42.85 and 41.64% saving in cost respectively when compared to the conventional method. Among the T_2, T_3 and T_4 the savings in cost was higher for the ridger seeder treatment. There was a savings of 96.4, 96.3 and 96.2% in time using the ridger seeder, pneumatic planter and cultivator seeder, respectively, when compared to the manual sowing.

Conclusion

1. The standard deviation, coefficient of variation and deviation from the recommended depth were less for the ridger seeder when compared to the other seeders. Thus more uniform depth of seed placement was obtained using the ridger seeder.
2. The planting operation using the ridger seeder, pneumatic planter and cultivator seeder resulted in 44.00, 42.85 and 41.64% savings in cost, respectively, when compared to the conventional method. Among the T_2, T_3 and T_4 the savings in cost was higher for the ridger seeder treatment.
3. There was a savings of 96.4, 96.3 and 96.2% in time using the ridger seeder, pneumatic planter and cul-

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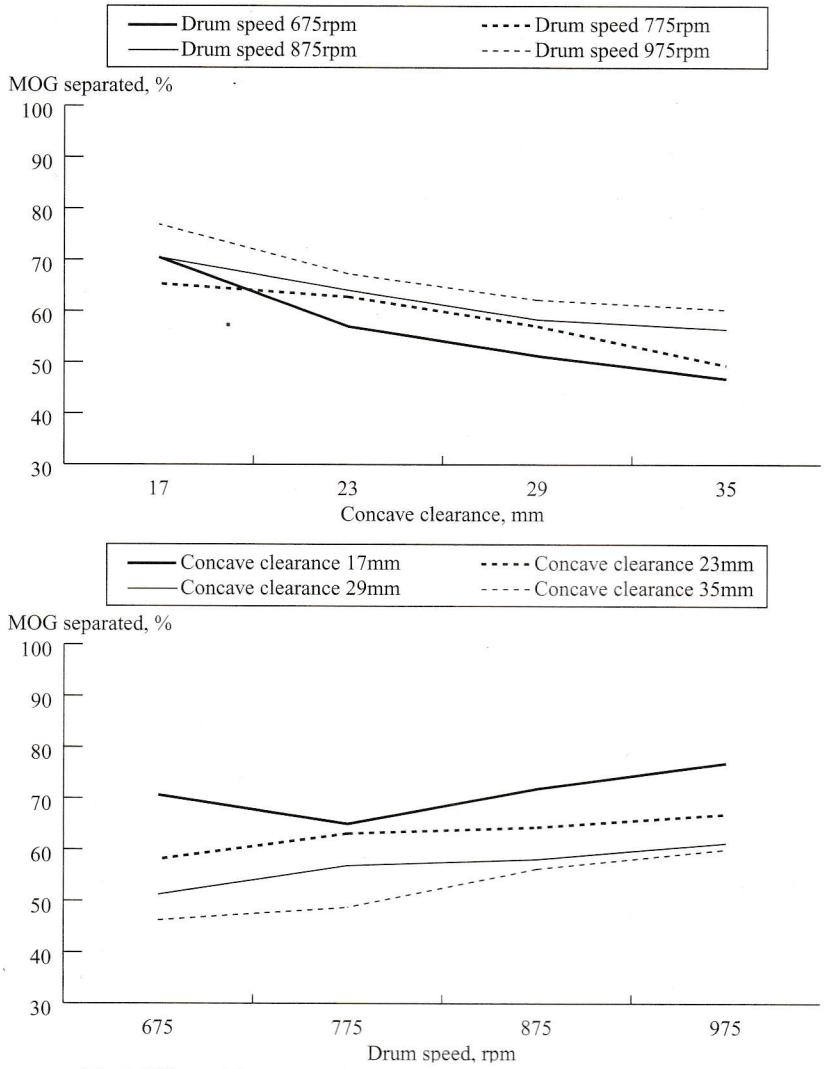

Fig.8 Effect of drum speed and concave clearance on MOG separation

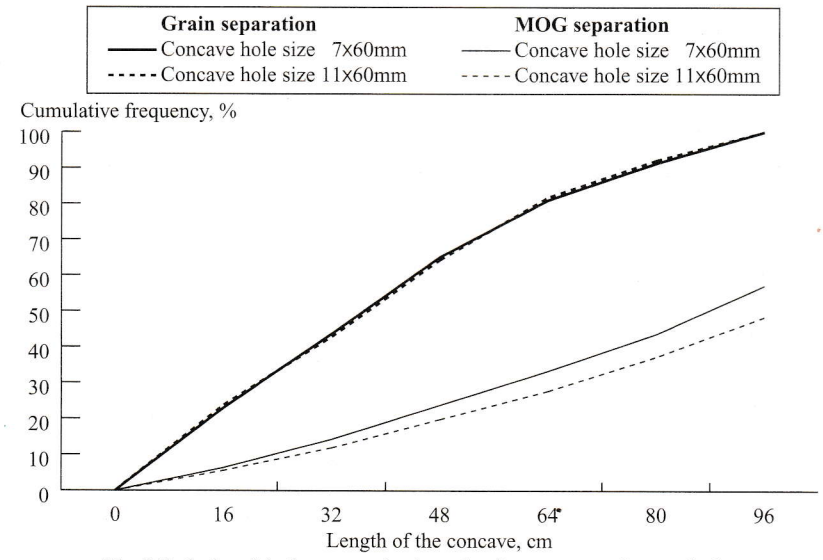

Fig.9 Relationship between the length of concave and cumulative separate grain and MOG with 3000kg(head)/h feed rate, 775rpm drum speed, 29 and 35mm concave clearance

ment. ASAE Standard S410, Agricultural Engineers Handbook, pp. 329-330.

Bansal, N. K., S. Agarwal and T.R. Sharma. 1994. Performance evaluation of a sunflower thresher. A paper presented at XXIX Annual Convention of the India Society of Agricultural Engineering,Hissar India, February 10-12.

Bhutta, M. S., M.S. Sabir and Z. Javaid. 1997. Comparative performance of different methods of sunflower threshing. Agricultural Mechanization in Asia, Africa and Latin America, 28(3):65-67.

Box, G. E., W.G. Hunter and J.S. Hunter.1978. Statistics for Experimenters. John Wiley and Sons, New York.

Friesen, Q. H.. 1971. Combines - Operation and Adjustment. Department of Agriculture, Extension Service Branch, Manitoba, Publication No. 470.

Gomez, K. A. and A. A. Gomez. 1984. Statistical Procedures for Agricultural Research. Second Edition, John Wiley & Sons, Inc., New York.

Hunt, D. 1995. Farm Power and Machinery. 9th Edition, Iowa State University Press, Ames, Iowa.

Jadhav, R. V. and J. S. Deshpande. 1990. Development and performance evaluation of a pedal-operated sunflower thresher. Agricultural Mechanization in Asia, Africa and Latin America, 21(3):30-32.

Kepner, R. A., R. Baine and E. L. Barger. 1978. Principles of Farm Machinery. 3rd Edition, The AVI Publishing Company Inc., West port, U.SA.

Naravani, N. B. and J. S. Panwar. 1994. Effect of impact mode of threshing on threshability of sunflower crop. A paper presented at XXIX Annual Convention of the India Society of Agricultural Engineering, Hissar India, February 10-12.

OAE. 1999. Agricultural Statistics of Thailand Crop Year 1999/2000.