*The Andhra Agric. J* 60(4):901-908, 2013

# Performance Evaluation of Tractor Drawn Seed Drills for Ground Nut in Dry Land

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**ABSTRACT**

India is basically dependent on rainfed agriculture. In dry land agriculture soil moisture dictates the priorities with regard to field operation and sowing. In this study five types of seed drills were evaluated for ground nut sowing and to assess their performance. The highest field capacity was 0.54 ha $h^{-1}$ for Ananta planter followed by 0.53 ha $h^{-1}$, 0.47 ha $h^{-1}$, 0.45 ha $h^{-1}$ and 0.43 ha $h^{-1}$ for Nandyala planter, Gujrat seed cum fertilizer drill, Kisan automatic planter and Local seed cum fertilizer drill respectively. The highest net income was obtained with Ananta planter. The study conferred that out of five seed drills the Ananta planter was given best performance as compared to others.

**Key words :** Dry Land Agriculture, Performance Evaluation, Seed Drill, Seed Metering Mechanisms,

Dry farming or dry land farming is a practice of growing a profitable crop without irrigation in areas, which receive an annual rainfall of 500 mm or even less. Dry lands contribute more than 40 per cent food grains. About 95 per cent of pulses and 75.5 per cent of oilseeds are also grown in these areas (Pandey and Ganesan, 2005). Thus, dry lands and rain fed farming will continue to play a dominant role in agricultural production.

Groundnut (Arachis hypogea L) is one of the important oil seed crop and in India and ranks second in the world (after China) in production. It is grown in an area of 8.4 million hectares with a production of 8.20 million tons in India (Anonymous, 2010). In dry land agriculture, soil moisture dictates the priorities with regard to field operation and time of sowing. Most of the farmers in India use traditional methods for planting. Traditional methods of crop planting have involved planting of excess seed and increase human drudgery. Therefore an investigation was carried out to evaluate the performance of existing tractor drawn seed drills with different seed metering mechanisms. The economics of operation was also carried out to provide required technical information to the farmers in order to choose the best seed drill/planter for ground nut in dry land cultivation.

## MATERIAL AND METHODS

The experiment was conducted at Agricultural Research Station, Anantapur during *kharif* 2011 in the extent of area about (100m x 30m) 3000 $m^2$. This area was divided into 5 equal plots of size 20m x 30m for conducting the field experiment with various seed drills for ground nut. The soil of the experimental site was found to be red sandy loam soil .

Five types of tractor drawn seed drills with different seed metering mechanisms viz., Ananta planter with inclined plate seed metering mechanism, Nandyala planter with horizontal plate seed metering mechanism, Kisan automatic planter with trough feed seed metering mechanism, guj rat seed cum fertilizer drill with cup feed seed metering mechanism and Local seed cum fertilizer drill with manual dropping seed metering mechanisms were tested in laboratory for calibration before the field experiment was conducted. The main features of seed drills are presented in Table 1. The calibration of seed drills were done with k-6 variety of ground nut seed. The calibration test procedure as per IS (Indian Standard) test code 6316:1993 is as follows.

i. The nominal width of coverage of the seed drill was measured by the following formula.

$$W = \frac{Nd}{100}$$

Where,

W= Nominal width, m

N= Number of furrow openers

d= Distance between two adjacent furrow openers, cm

ii.Circumference of the driving wheel was measured by the following formula.

$$L = \frac{\pi D}{100}$$

Where,

L= Circumference of the driving wheel, m

D= Diameter of the driving wheel, cm

iii. Area covered in one revolution of driving wheel was calculated by the following formula.

A= WL

Where,

A = Area covered in one revolution of driving wheel, $m^2$

L = Circumference of the driving wheel, m

W = Nominal width, m

iv. Number of revolutions to cover 1/25 ha area was calculated. This was calculated dividing 400 $m^2$ by area covered in one revolution of the driving wheel.

v. The driving wheel was made free to rotate by jack up the drill. A mark was put on the driving wheel so that the revolutions may be counted easily. The bags or containers placed under each boot or furrow opener. The seed hopper was filled with selected seed for conducting the test and rate control setting was adjusted.

vi. The driving wheel was practiced to rotate for fixed number of rotations calculated above, the weight of the seed was measured which was dropped in the bags or containers under each furrow opener.

vii. Calculated the seed dropped in kg $ha^{-1}$ and the data were recorded in data sheet.

viii. Above procedure was repeated till the required seed rate was obtained.

After completion of the calibration test the field experiments were conducted with the same seed. To evaluate the performance of the five seed drills the following parameters has been considered.

**1. Soil parameters, viz moisture content and bulk density of the soil**

**a) Moisture content of the soil**

To determine the moisture content, soil samples were taken up to the full depth of core sampler i.e. 115 mm and weighed. Moisture content was determined by oven dry method i.e., keeping in oven for 24 h at $105^0$ C.

$$MC = \frac{w_1 - w_2}{w_2} \times 100$$

Where, MC = Moisture content, per cent on dry basis

$w_1$ = Weight of the wet sample, g

$w_2$ = Weight of the oven dried sample, g

**b) Bulk density of soil**

Bulk density of a soil is defined as mass per unit volume. Soil samples were collected randomly from each location of experimental plot with a core sampler. The collected samples were kept in an oven at 105 $^0$C for 24 h. The bulk density of each sample was calculated by using the following relationship.Bulk density, g/

$$cc = \frac{Dry\ weight\ of\ soil\ sample,\ \ g}{Volume\ of\ soil\ sample,\ \ cc}$$

**2. Machine and operational parameters include average operating time, speed of operation, effective field capacity, field efficiency and field machine index**

**a) Operating time for each operation**

To determine operating time, time was noted at starting and ending point of sowing by using stop watch, so that actual time required for sowing by seed drills was computed in terms of h/ha. The time required for one turn of seed drill and time consumed for adjustments were also noted to compute time loss in operation.

**b) Speed of operation**

To determine the speed of operation, mark the length of 25 m and the drill was operated in the marked run length. A stop watch was used to record

the time for the drill to traverse the marked run so that the speed of travel was computed in m $s^{-1}$.

**c) Effective field capacity**

Effective field capacity was measured by the actual area covered by the implement, based on its total time consumed and its width. Effective field capacity was determined by the following relationship.

Effective field capacity, ha $h^{-1}$ =

$$\frac{Total\ area\ covered,\ \ ha}{Total\ timetaken,\ \ h}$$

**d) Field efficiency**

Field efficiency is the ratio of effective field capacity to theoretical field capacity. It was determined by the following formula

Field efficiency, % =

$$\frac{Effective\ field\ capacity,\ \ \left(\frac{ha}{h}\right)}{Theoretical\ \ field\ capacity,\ \ \left(\frac{ha}{h}\right)} \times 100$$

Theoretical field capacity is the rate of field coverage of the implement, based on 100 per cent of time at the rated speed and covering 100 per cent of its rated width. The theoretical field capacity was determined using the following relationship

Theoretical field capacity, ha $h^{-1}$

$$= \frac{Width(m) X Speed\left(\frac{km}{h}\right)}{10}$$

**e) Field machine index**

It indicates the influence of field geometry on working capacity of a machine. Field machine index was worked out by the following formula.

$$FMI = \frac{T_p}{T_p + T_t} \quad x\ 100$$

Where,

FMI= Field machine index, %

$T_p$ = Total productive time, min

$T_t$ = Turning time loss, min

**3. Sowing parameters include seed rate, depth of sowing and seed to seed spacing**

**a) Seed rate**

The seed rate was determined by taking the weight of seed before and after sowing operation. Then subtracted the final weight of seed from initial weight of seed so that the seed rate was obtained and the results were expressed in terms of kg $ha^{-1}$.

**b) Depth of sowing**

Depth of sowing of seeds was determined with the help of steel scale of 0.3m. Twenty random observations were taken for each plot and their mean was calculated to represent the depth of sowing.

**c) Seed to seed spacing**

Seed to seed spacing was measured by a steel scale of 0.30 m length after sowing. The soil was removed carefully without disturbing the seeds at minimum five random places in 10 rows and the mean was determined to represent seed to seed spacing.

**4. Crop parameters include average plant population, plant height, no. of pods per plant, pod yield, halum yield and harvest index.**

**a) Average plant population**

The average plant population was determined by count the number of plants per square metre at five random places and the mean value was determined to represent the average plant population.

**b) Plant height**

Plant height was measured from the base of stem to the tip of the top most leaf at five randomly selected areas. The plant height was recorded at different intervals viz., vegetative stage, flowering stage, podding stage, maturity stage and harvesting stage.The mean plant height was calculated and expressed in cm.

**c) Number of pods per plant**

The pods from five randomly selected plants were separated and total pods was counted and average number of pods per plant was recorded.

Table 1. Main features of 5 types of seed drills.

| S.No. | Name of seed drill | No. of furrow openers | Row spacing, m | Effective operating width, m | Type of seed metering mechanism | Dimensions of seed drills (LXBXH), cm |
|---|---|---|---|---|---|---|
| 1. | Ananta planter | 8 | 0.30 | 2.4 | Inclined plate | 255x97x110 |
| 2. | Nandyala planter | 8 | 0.30 | 2.4 | Horizontal plate | 255x97x128 |
| 3. | Kisan automatic planter | 8 | 0.30 | 2.4 | Trough feed | 255x98x157 |
| 4. | Gujrat seed cum fertilizer drill | 8 | 0.30 | 2.4 | Cup feed | 243x107x130 |
| 5. | Local seed cum fertilizer drill | 8 | 0.30 | 2.4 | Manual dropping | 255x92x161 |

Table 2. Data for machine and operational parameters of seed drills for ground nut .

| S.No. | Parameters | Ananta planter | Nandyala planter | Kisan automatic planter | Gujrat seed cum fertilizer drill | Local seed cum fertilizer drill |
|---|---|---|---|---|---|---|
| 1 | Plot area, $m^2$ | 600 | 600 | 600 | 600 | 600 |
| 2 | Speed of operation, kmph | 3.17 | 2.95 | 2.71 | 2.79 | 2.62 |
| 3 | Effective field capacity, ha h-1 | 0.54 | 0.54 | 0.45 | 0.47 | 0.43 |
| 4 | Theoritical field capacity, ha h-1 | 0.76 | 0.7 | 0.65 | 0.67 | 0.62 |
| 5 | Field efficiency, % | 71.9 | 71.27 | 70.08 | 70.07 | 69.17 |
| 6 | Actual operating time for test plot, h | 0.1095 | 0.1189 | 0.1315 | 0.1276 | 0.1379 |
| 7 | Time lost for turnings and adjustments, s | 35 | 41 | 47 | 49 | 55 |
| 8 | Field machine index, % | 91.12 | 90.42 | 90.07 | 89.33 | 88.92 |
| 9 | Fuel consumption, l $h^{-1}$ | 4.405 | 4.44 | 3.99 | 4.2 | 3.82 |
| 10 | Fuel consumption, l $ha^{-1}$ | 8.04 | 8.8 | 8.75 | 8.95 | 8.8 |

Table 3. Data sheet for sowing parameters of seed drills for Ground nut.

| S.no. | Name of seed drill | Seed rate obtained, kg $ha^{-1}$ | Average depth of sowing, cm | Average seed to seed spacing, cm |
|---|---|---|---|---|
| 1 | Ananta planter | 102.45 | 7.7 | 9.8 |
| 2 | Nandyala planter | 109.92 | 7.3 | 8.4 |
| 3 | Kisan automatic planter | 123.55 | 5.9 | 9.5 |
| 4 | Gujrat seed cum fertilizer drill | 126.45 | 6.0 | 9.0 |
| 5 | Local seed cum fertilizer drill | 130.72 | 7.5 | 7.4 |

**d) Pod/seed yield**

Pod/seed yield was determined from 1 $m^2$ area. Five random observations were taken from each field and thoroughly dried under sun. After completion of sun drying, the pods are separated from plants and the weight of podsfor ground nut, weight of seeds for Bengal gram and weight of seeds for red gram were recorded and the conserved to kg $ha^{-1}$.

**e) Halum/stalk yield**

The halum/stalk yield was determined from 1 $m^2$ area. Five observations were taken from each plot was sun dried thoroughly. After sun drying the halum weights for ground nut and Bengal gram were recorded and stalk weight for red gram was recorded andexpressed in kg $ha^{-1}$.

**f) Harvest index**

Harvest index is the ratio of pod yield to the total biological yield (pod + halum) and expressed in percentage by using the formula, given below:
Pod yield (kg $ha^{-1}$)

$$\frac{\text{Harvest index,\%}}{\text{Pod yield (kg ha}^{-1}\text{) + halum yield (kg ha}^{-1}\text{)}} \times 100$$

**5. Cost analysis which includes fixed cost and operating cost were carried out.**

**a) Fixed cost**

Fixed cost includes depreciation, interest, housing, insurance and taxes.

**I. Depreciation**

It is the loss of value a machine with the passing of time.

$$D = \frac{C - S}{L\,H}$$

Where,
C = Capital cost
D = Depreciation, Rs. /h
S = Salvage value, 10 per cent of capital
H = Number of working hours per year, and
L = Life of machine, year

**II. Interest**

Interest was calculated on the average investment of the machine taking into consideration the value of in first and last year.

$$I = \frac{C + S}{2} x \frac{i}{H}$$

Where,
I = interest per year
I = interest rate per year, per cent
C = Capital cost

**III. Housing, insurance and taxes**

Housing, insurance and taxes for the seed drills, each one was taken as the 1 per cent of the initial investment of the seed drill.

**b) Operating cost**

Operating cost includes fuel cost, lubricants, repairs, maintenance, and other costs.

**I Fuel cost**

Fuel cost was calculated on the basis of actual fuel consumption of the machine.

**ii Repairs and maintenance**

Cost of repairs and maintenance was taken as 5 per cent of the initial investment of the machine.

**c) Other costs**

It includes wages for operator, labour cost based on the prevailing market rates per day of 8 hours.

## RESULTS AND DISCUSSION

Seed rates for the ground nut seed observed was 100.45 kg $ha^{-1}$, 109.15 kg $ha^{-1}$, 121.45 kg $ha^{-1}$, 125.72 kg $ha^{-1}$, for the tractor drawn seed drills viz., Ananta planter, Nandyala planter, Kisan automatic planter and Gujrat seed cum fertilizer drill respectively in the calibration test. The recommended seed rate for ground nut was 100-130 kg $ha^{-1}$. The calibrated values were just approaching to the recommended value. Therefore these values of seed drills were recommended for ground nut crop. The bulk density of the field at the time of sowing was observed as 1.47 g/c.c. The moisture content of the field at the time of sowing was observed as 21.22%.

The highest field capacity was found to be 0.54 ha $h^{-1}$ for Ananta planter with field efficiency of 71.9% at an average speed of 3.17 kmph followed by 0.54 ha $h^{-1}$, 0.47 ha $h^{-1}$and 0.45 ha $h^{-1}$

Table 4. Results of Net income for ground nut crop.

| S.No. | Name of seed drill | Net income for ground nut crop Rs. ha$^{-1}$ |
|---|---|---|
| 1 | Ananta planter | 45093.54 |
| 2 | Nandyala planter | 37771.24 |
| 3 | Kisan automatic planter | 31781.9 |
| 4 | Gujrat seed cum fertilizer drill | 28952.02 |
| 5 | Local seed cum fertilizer drill | 36345.42 |

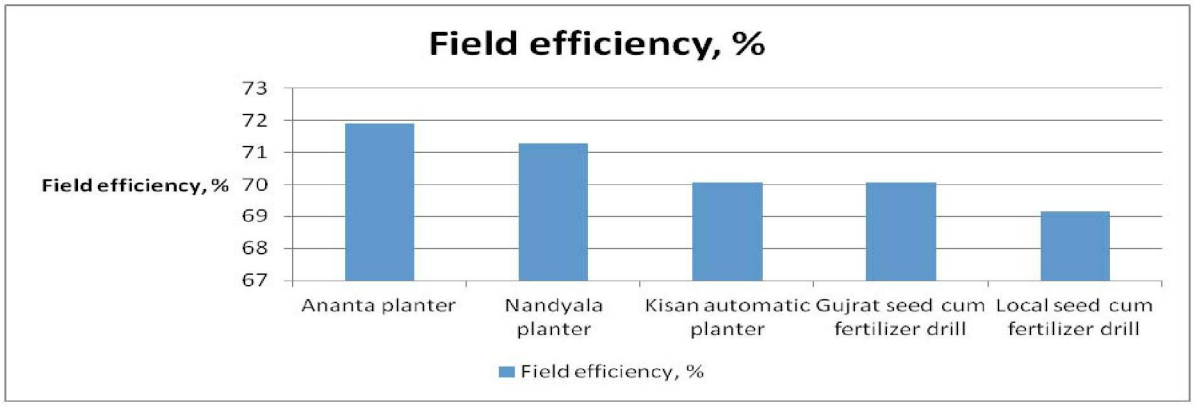



Fig 2. Seed rates of various seed drills for Ground nut crop.

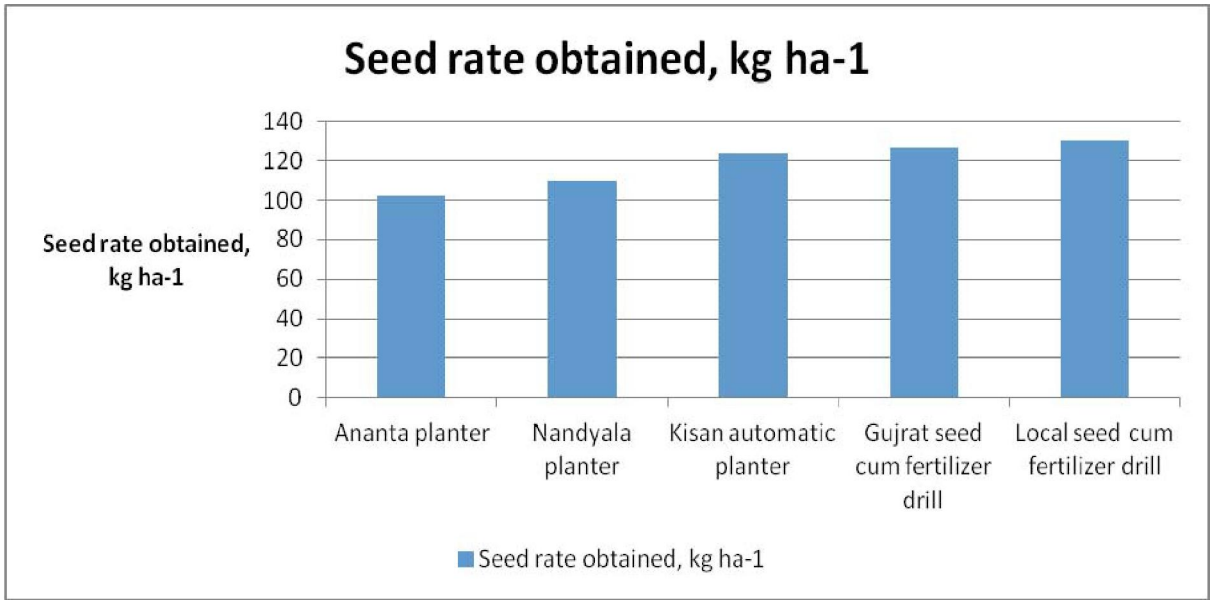
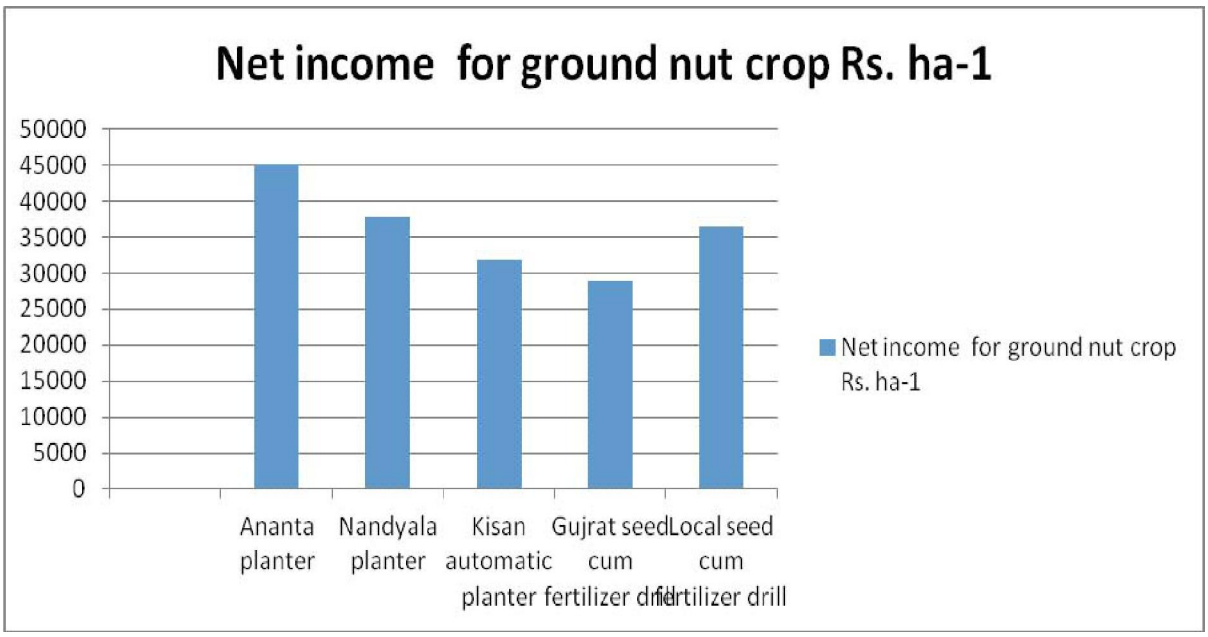


Fig 3. variation of cost income for various seed drills.




with an field efficiency of 71.27%, 70.07% and 70.08% at an average speed of 2.95kmph, 2.79kmph and 2.71kmph for Nandyala planter, Gujrat seed cum fertilizer drill and Kisan automatic planter respectively. The lowest field capacity was found to be 0.43 ha $h^{-1}$ for Local seed cum fertilizer drill with field efficiency of 69.17% at an average speed of 2.62 kmph. The results are presented in Table 2 and shown in fig 1.

The lowest seed rate obtained in the field for Ground nut was observed as 102.45 kg $ha^{-1}$ with an average seed spacing of 9.8 cm for Ananta planter whereas highest seed rate obtained was found to be 130.72 kg $ha^{-1}$ with an average seed spacing of 7.43 cm for Local seed cum fertilizer drill. The seed rates obtained in the field were almost within the range of recommended seed rate for Ground nut. The highest average depth of sowing was obtained as 7.7 cm for Ananta planter and lowest depth of sowing was obtained as 5.9 cm for Kisan automatic planter. The results are presented in Table 3 and variation of seed rates of seed drills are shown in fig 2.

The highest plant population for ground nut crop was found to be 40.47 for Local seed cum fertilizer drill whereas the lowest plant population was found to be 32.32 for Ananta planter. The highest pod yield obtained for Ground nut crop was found to be 1154.16 kg $ha^{-1}$ for Ananta planter whereas the lowest pod yield was found to be 895.83 kg $ha^{-1}$for Gujrat seed cum fertilizer drill. The highest halum yield was found to be 2520.83 kg $ha^{-1}$ for Nandyala planter and the lowest halum yield was found to be 1895.83 kg $ha^{-1}$ for Gujrat seed cum fertilizer drill. The operating cost of seed drills are presented in Table 4. The gross income was determined by selling the obtained yield for ground nut crop. The market price for Ground nut cost was found to be Rs 5000/q, Halum of Ground nut cost was found to be Rs. 2000/t. The highest net income was found to be Rs 45093.54 per ha for Ananta planter whereas the lowest net income was found to be Rs.28952.02 for Gujrat seed cum fertilizer drill the results are presented in Table 5 and the variation of income for various seed drills are shown in fig3

## CONCLUSIONS

The following conclusions are drawn from the study

1. It was observed that the performance of Ananta planter was satisfactory for ground nut among all seed drills.
2. The highest field capacity was found to be 0.54 ha $h^{-1}$ with field efficiency of 71.9 per cent for Ananta planter among all seed drills.
3. The lowest seed rate obtained in the field was observed as 102.45 kg $ha^{-1}$ for Ananta planter whereas the highest seed rate was observed as 130.72 kg $ha^{-1}$ for local seed cum fertilizer drill among all seed drills.

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(Received on 16.06.2012 and revised on 08.11.2012)