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Performance Evaluation Of Different Seed Metering Mechanisms For Dry And Soaked Redgram Seed

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ABSTRACT
In the present study three types of seed metering mechanism were evaluated for redgram to assess the performance viz. inclined plate seed metering mechanism, horizontal plate seed metering mechanism and vertical plate seed metering mechanism. The seed rate obtained were 10.27, 11.44, and 10.66 respectively. The breakage of redgram dry seed 0.6, 1.2 and 1.8 g respectively for all three seed metering mechanism under laboratory conditions. The breakage of dry redgram was found to be less percentage in case of vertical plate seed metering mechanism. Hence vertical plate seed metering mechanism was selected for sowing in field conditions. The breakage of soaked redgram at all the soaked intervals viz. 6 h, 12 h, 18 h and 24 h respectively and also for all the threes seed metering mechanisms were found to be at higher rate i.e. more than 5%. Hence it was found that the seed drill could not perform effectively for sowing soaked groundnut seed under laboratory conditions for all the three seed metering mechanisms. Hence soaking of sowing groundnut was not considered for sowing under field conditions.
***Key words**: red gram, ground nut, inclined plate, horizontal plate mechanism and vertical plate.*

INTRODUCTION

Agriculture is one of the most important sectors of Indian economy both in terms of gross national product and number of productive workers employed. 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.About 44 per cent of total food production comes from 67 per cent of total cultivated area, which is rain dependent. India has about 47 million hectares of dry lands out of 108 million hectares of total rain fed area. Dry lands contribute more than 40 per cent food grains (80 per cent maize, 95 per cent of pearl millet and sorghum). About 95 per cent of pulses and 75.5 per cent of oilseeds are also grown in these areas. Thus, dry lands and rain fed farming will continue to play a dominant role in agricultural production.

Red gram (*Cajanuscajan L*)is commonly known as Tur or Arhar (Pigeon pea) in India and is the second important pulse in the country after gram (chana). The ability of red gram to produce high economic yields under soil moisture deficit makes it an important crop in rain-fed and dryland agriculture.

It can be grown under variable soil moisture conditions, with rainfall ranging from 600 mm to 1400 mm. Production in India accounts for about 65% of the total global output as per the latest FAO statistics.Area and production of red gram in India has been more or less stable at 3.5-4 million hectares and 2.5–3 million metric tons respectively during the past two decades. The wide fluctuations in yields could be attributed to the dependence on rainfall as majority of the crop is grown under rain-fed conditions.Maharashtra is the largest producer of red gram, accounting for over 35% of total production in the country, followed by Karnataka, Madhya Pradesh, Uttar Pradesh, Gujarat and Andhra Pradesh. In India, area under red gram was 3.70 M ha and production 2.80 MT during 2015. In Andhra Pradesh, the area under red gram is 1.51 Lakh hectares and production is 0.76 Lakh tonnes during 2014-15 (DES, 2015).

However there are no studies on the performance of existing seed metering mechanisms with soaked seed. Hence, there is a strong need for assessing the performance of existing seed metering mechanisms for planters with sprouted seed and study of planter for redgram in actual field conditions.

MATERIAL AND METHODS

The laboratory experiments were conducted to study the performance evaluation of seed metering mechanisms with soaked seed for redgram crop at Agricultural Research Station, Ananthapuramu during the year of 2016-17. The laboratory experiments were conducted using three commercial available seed metering mechanism suitable for groundnut. The existing of different seed metering mechanisms are shown in plate 1 to plate 3 and the main specifications of the commercially available seed metering mechanisms are given in Table 1.

It was necessary to calibrate the planters for redgram soaked seed to find desired seed rate. Calibration was done to get the pre-determined seed rate of the machine. The planters were calibrated in the laboratory at ARS, Ananthapuramu as per BIS test code IS 6316: 1993 for redgram.

Determination of seed rate for different seed metering mechanisms

It was necessary to calibrate the planters before conducting field test for ground nut andred gram for both dry and soaked seeds to find the desired seed rate. The planters were calibrated by the standard method (as per BIS test code 6316:1993). The standard procedure was given below.

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 $1/25^{th}$ 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 were 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.

Above procedure was repeated till the required seed rate was obtained

Seed damaged test

Seed damage test for soaked seed was done in laboratory condition. In each hopper 500 g of seed was placed. The wheel was rotated 20 times in turns and the time taken to complete the revolution was recorded with aid of stop clock. The seeds discharged from each spout were observed for any external damage (Issac and Sunday 2006)

RESULTS AND DISCUSSION

Redgram (dry seed)

Seed rates for the redgram dry seed observed were 10.27, 11.44 and 10.66 kg ha^{-1} respectively for the different seed metering mechanisms viz. vertical plate, inclined plate and horizontal plate metering

mechanisms respectively in the calibration test. The results obtained for redgram seed by calibration test for different metering mechanisms are presented in Table 2 to 4.

The breakage of seed was observed 0.6, 1.2 and 1.8 g for vertical, inclined and horizontal plate metering mechanisms respectively. The breakage of dry redgram seed was found to be less percentage in case of vertical plate metering mechanism. Hence vertical plate metering mechanism was selected for sowing in the field. The observed results are presented in Table 5.

Redgram (soaked seed)

The breakage of the seed at all the soaked intervals and also for all the three seed metering mechanisms were found to be at higher rate i.e. more than 5%. Hence it was found that the seed drill could not perform effectively for sowing soaked groundnut seed under laboratory conditions for all the three seed metering mechanisms. Hence soaking of sowing groundnut seed was not considered for sowing under field conditions. The observed values are presented in Table 6.

CONCLUSIONS

1. Seed rates for the redgram dry seed observed were 10.27, 11.44, 10.66kg ha^{-1} respectively. The breakage of varying redgram dry seed was observed 0.6, 1.2, 1.8 g respectively for vertical, inclined and horizontal plate metering mechanisms respectively.
2. The breakage of dry redgram seed was found to be less percentage in case of vertical plate metering mechanism. Hence vertical plate metering mechanism was selected for sowing in the field.
3. The breakage of the redgram soaked seed at all the soaked intervals and also for all the three seed metering mechanisms were found to be at higher rate i.e. more than 5%.
4. Hence it was found that the seed drill could not perform effectively for sowing soaked redgram seed under laboratory conditions for all the three seed metering mechanisms.
5. Hence soaking of sowing redgram seed was not considered for sowing under field conditions.

Table 1. Specifications of the commercially available seed metering mechanisms

S. No	Seed metering mechanism	No. of furrow openers	Row spacing (m)	Operating width (m)	Dimensions of planter/seed drill (lxbxh) (cm)
1	Inclined plate	8	0.30	2.4	255x97x110
2	Horizontal plate	8	0.30	2.4	255x97x128
3	Vertical plate	8	0.30	2.4	255x98x157

Table 2.Calibration of the Vertical plate metering mechanism for redgram (dry seed)

Test no.	Weight of seed discharged in 114 revolution of ground wheel			Weight of seed collected from all furrow openers (kg)	Seed rate (kg ha^{-1})	Average seed rate (kg ha^{-1})
	Row 1	Row 2	Row 3			
1	0.143	0.124	0.143	0.41	10.22	10.27
2	0.141	0.128	0.146	0.42	10.34	
3	0.143	0.124	0.143	0.41	10.22	
4	0.143	0.127	0.144	0.41	10.32	
5	0.142	0.126	0.143	0.41	10.25	

Table 3.Calibration of the Inclined plate metering mechanism for redgram (dry seed)

Test no.	Weight of seed discharged in 114 revolution of ground wheel			Weight of seed collected from all furrow openers (kg)	Seed rate (kg ha^{-1})	Average seed rate (kg ha^{-1})
	Row 1	Row 2	Row 3			
1	0.157	0.167	0.13	0.45	11.32	11.44
2	0.152	0.179	0.131	0.46	11.52	
3	0.154	0.172	0.131	0.46	11.39	
4	0.153	0.176	0.133	0.46	11.52	
5	0.155	0.172	0.132	0.46	11.44	

Table 4.Calibration of the Horizontal plate metering mechanism for redgram (dry seed)

Test no.	Weight of seed discharged in 114 revolution of ground wheel			Weight of seed collected from all furrow openers (kg)	Seed rate (kg ha^{-1})	Average seed rate (kg ha^{-1})
	Row 1	Row 2	Row 3			
1	0.143	0.138	0.143	0.42	10.57	10.66
2	0.142	0.141	0.146	0.43	10.69	
3	0.143	0.143	0.143	0.43	10.69	
4	0.144	0.141	0.144	0.43	10.69	
5	0.143	0.142	0.143	0.43	10.67	

Table 5. Percentage seed damage of redgram (dry seed)

Number of seed discharged in 20 revolution of ground wheel					
Metering mechanism	**Hopper**	**No of seeds Discharged (g)**	**No of seeds Damaged (g)**	**Percentage damage (%)**	**Average damage (%)**
Vertical plate	1	116	1	0.9	0.6
	2	120	0	0.0	
	3	122	1	0.8	
Inclined plate	1	110	2	1.8	1.2
	2	113	1	0.9	
	3	115	1	0.9	
Horizontal plate	1	95	2	2.1	1.8
	2	98	2	2.0	
	3	88	1	1.1	

Table 6. Percentage seed damage of redgram (soaked seed)

Seed metering mechanism	Hopper	Percentage damage (%)		Average damage (%)	
		Soaked at 6 h	Soaked at 12 h	Soaked at 6 h	Soaked at 12 h
Vertical plate	1	5.0	5.0	5.2	5.4
	2	4.4	5.3		
	3	6.1	5.9		
Inclined plate	1	5.4	5.5	5.1	5.7
	2	5.0	5.1		
	3	4.9	6.5		
Horizontal plate	1	5.1	5.7	5.4	6.2
	2	5.3	6.6		
	3	5.7	6.2		
Seed metering mechanism		**Soaked at 18 h**	**Soaked at 24 h**	**Soaked at 18 h**	**Soaked at 24 h**
Vertical plate	1	8.8	9.7	8.1	9.2
	2	7.8	8.9		
	3	7.8	8.9		
Inclined plate	1	7.3	9	7.6	8.9
	2	7.6	9.2		
	3	7.9	8.5		
Horizontal plate	1	8.8	9.8	8.5	9.7
	2	8.5	10		
	3	8.1	9.2		

Plate 1. Inclined plate seed metering mechanism

Plate 2. Horizontal plate seed metering mechanism

Plate 3. Vertical plate seed metering mechanism

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