THIS REPORT VALID UPTO: 10/10/2025

COMMERCIAL TEST REPORT

SEED CUM FRTILIZER DRILL (TRACTOR DRAWN)

FARM MACHINERY TESTING AND TRAINING CENTRE,
DEPARTMENT OF FARM POWER AND MACHINERY,
Dr. PANJABRAO DESHMUKH KRISHI VIDYAPEETH,
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(The Institute is approved Testing Center of Agriculture & Cooperation, Ministry of Agriculture, GOI vide letter No. 8-1/2004-My(I&P) Dated 30th March 2012-Addendum)

Manufacturer : **M/s. Sandeep Agro Works,**
Near Buldhana Urban Ware House,
Akola Road, Akot,
Dist. : Akola (M.S.) - 444 101

Inward / Outward
No PI/FMTT&PC/268 /10/10/2018
Dated 10/10/2018

Report No.Imp-TR-62/136 **Month: Oct.** **Year: 2018**

FARM MACHINERY TESTING AND TRAINING CENTRE, DEPARTMENT OF FARM POWER AND MACHINERY, Dr. PANJABRAO DESHMUKH KRISHI VIDYAPEETH, AKOLA (M.S.)-444 104

(The Institute is approved Testing Center of Agriculture & Cooperation, Ministry of Agriculture, GOI vide letter No. 8-1/2004-My(I&P) Dated 30th March 2012-Addendum

Type of test	: **Commercial**
Test code referred	: IS: 6316-2004 (Sowing equipment-Seed cum Fertilizer Drill – Test Code). IS: 6813-2006 (Sowing Equipment - Seed cum Fertilizer Drill – Specifications). and IS: 4468 – 1997 (Specification for Three Point Linkage)
Period of test	: Feb. 2018- Oct. 2018
Test Report No	: IMP-TR-62/136
Month & Year	: Oct., 2018

i) The results reported in this report are observed values and no corrections have been applied for atmospheric and site conditions.

ii) The data given in this report pertains to the particular machine submitted by the applicant for test.

iii) The results presented in this report do not in any way attribute to durability of the machine.

iv) The report should not be produced in part or full without prior permission of the Head, Department of Farm Power and Machinery, Dr. PDKV, Akola (M.S.)-444104.

SELECTED CONVERSIONS

S. No	Units	Conversion Factor
1	**Force**	
	1 kgf	9.80665 N
		2.20462 lbf
2	**Power**	
	1 hp	1.01387 metric hp (Ps)
		745.7 W
	1 Ps	735W
	1 kW	1.35962 Ps

TYPE OF MACHINE	:	SEED CUM FERTI DRILL
MAKE	:	SANDEEP AGRO
MODEL	:	7 SD-DISC
MANUFACTURER BY	:	M/S. SANDEEP AGRO WORKS. NEAR BULDHANA URBAN WARE HOUSE. AKOLA ROAD, AKOT. DIST. : AKOLA (M.S.) - 444 101
TEST REQUESTED BY	:	M/S. SANDEEP AGRO WORKS. NEAR BULDHANA URBAN WARE HOUSE. AKOLA ROAD, AKOT. DIST. : AKOLA (M.S.) - 444 101
TEST CONDUCTED BY	:	FARM MACHINERY TESTING AND TRAINING CENTRE, DEPARTMENT OF FARM POWER AND MACHINERY, Dr. PANJABRAO DESHMUKH KRISHI VIDYAPEETH, AKOLA (M.S.) PIN -444 104

CONTENTS

1. SCOPE OF TEST

The purpose of test was to check and assess the following: -

1.1 LABORATORY TEST: -

-Checking of specifications.
-Metering mechanism to meter seed and fertilizer at desired rate.
-Variation in dropping of seed in different openers.
-Variation of seed rate due to quantity of seed in the seed box.
-Evenness of seed distribution.
-Visible damage to seed caused by metering mechanism.
-Hardness and chemical composition of the soil engaging parts i.e. furrow openers.

1.2 FIELD TEST: -

-Rate of work.
-Quality of work
-Ease of operations and adjustments
-Labour requirement
-Breakdowns and repairs

2. METHOD OF SELECTION

The applicant directly submitted the machine for test at this Institute. The method of selection is not known.

3. TEST PROCEDURE

The implement was tested in accordance with the relevant test codes IS: 6316-2004 (Sowing equipment-Seed cum Fertilizer Drill – Test Code), IS: 6813-2006 (Sowing Equipment - Seed cum Fertilizer Drill – Specifications), and IS: 4468 – 1997 (Specification for Three Point Linkage)

4. SPECIFICATIONS

4.1	GENERAL:		
	a) Name	:	Seed Cum Fertilizer Drill
	b) Type	:	Tractor Mounted Seed cum Fertilizer Drill
	c) Make	:	Sandeep Agro
	d) Serial	:	Not mentioned
	e) Model	:	7 SD-DISC
	f) Year of manufacture	:	2017
	g) Different seeds which the drill is designed to sow.	:	Wheat, Soyabean, Gram, Sorghum etc.
	h) Source of power	:	Tractor
	i)Recommended travelling speed of the drill	:	9 km/h recommended by manufacturer
	j)Recommended power of tractor (if tractor operated)	:	Above 35 hp tractor
	k) Location of fertilizer outlet in relation to seed outlet.	:	15 mm from the seed outlet

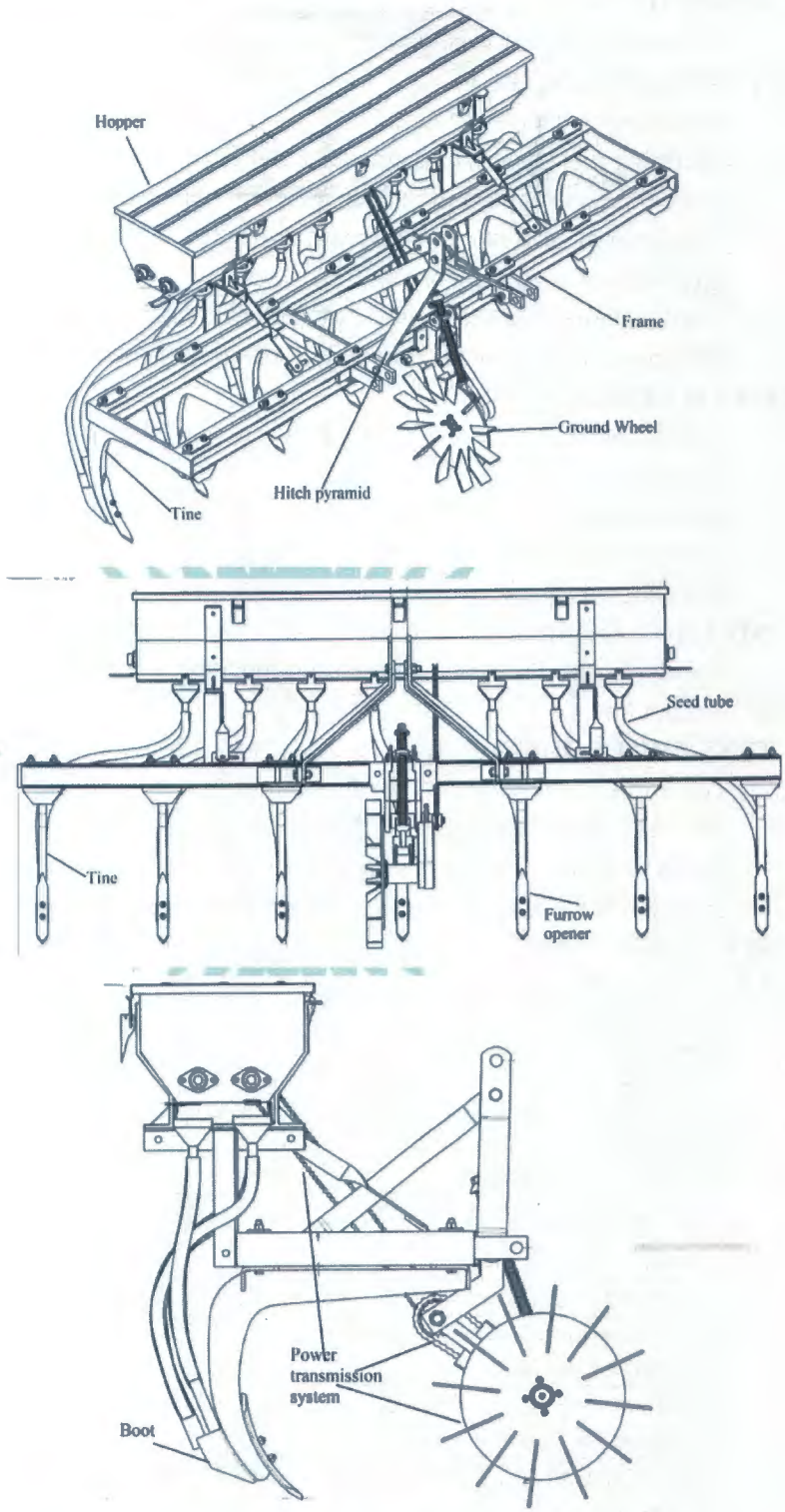

Fig. 1: Schematic diagrams of seed cum fertilizer drill

4.2 FURROW OPENERS

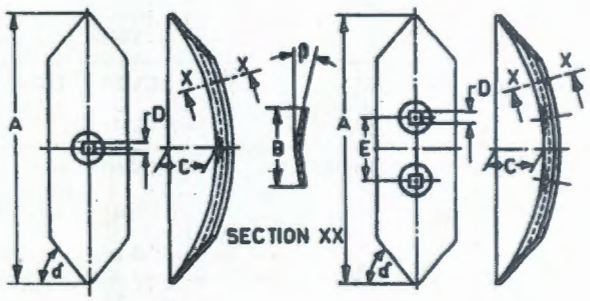

Fig.2 Furrow openers as per IS

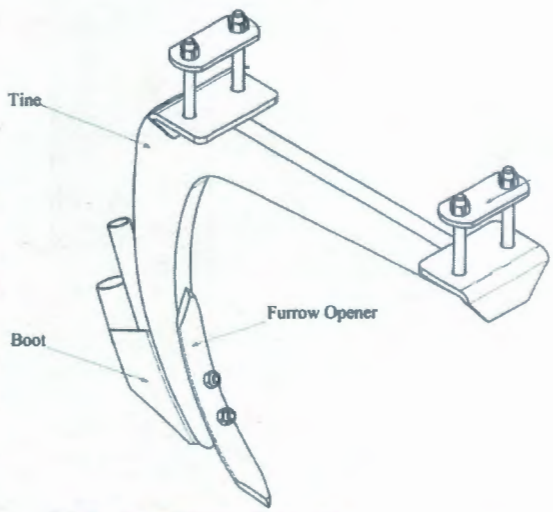

Fig.3 Furrow openers, boot and tine assembly

Type	:	Reversible shovel type

Specification of shovel as per IS: 6813: 2000

Sr. No	Notation	As per IS, mm	As Observed, mm	Conformity to IS
1	A	150± 2 or 170± 2 or 180 ± 2	285	Does not Conforms
2	B	35± 2 or 45± 2	45	Conforms
3	C	25± 1 or 30 ±1	25	Conforms
4	D	11.5 ± 0.5	13 (circular)	Does not Conforms
5	E	45 ± 0.5	45	Conforms
6	α	45 ± 5, degree	60	Does not Conforms
7	ß	10-20	13	Conforms

	Type and tilt angle with respect to vertical	:	10^{o} to 15^{o}
	No. of openers	:	Seven
	Arrangement of openers	:	Seven furrow openers fitted on tines of rear beam of the frame
	Range if selection of openers	:	Seven
	Method of changing row space and range	:	Fixing of tines through MS angle by means of nut and bolt
	Nominal width (cm)	:	7 x 38
	Lifting and lowering of openers	:	No arrangement is provided
	Depth control	:	Depth controls is achieved through hydraulic system
	Fertilizer placement with respect to seeds.	:	15mm below the seed in the same line
4.3	**METERING MECHANISM:**		
	1) Seed metering device:		
	Type	:	Seed Plate Type
	Size of feed shaft (mm)	:	1750 in length and 52 ϕ
	Size (dia. of hole. mm)	:	15 holes of 6-16 in diameter ϕ on seed plate

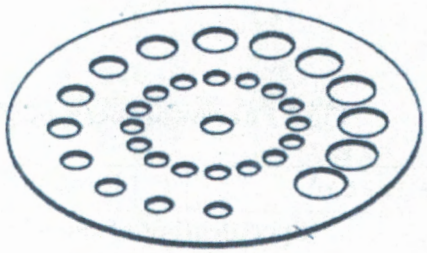

Fig.4 Seed plate of seed metering mechanism

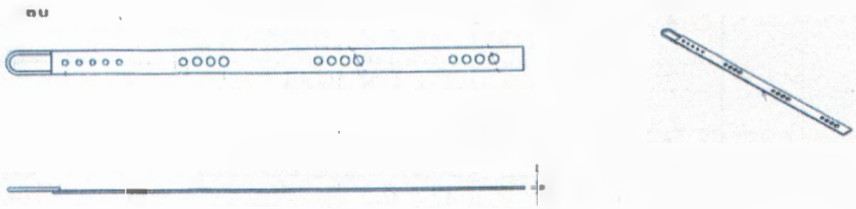

Fig. 5 Plate type fertilizer metering mechanism

	Source of power (ground wheel or other)	:	Ground wheel
	Transmission ratio of shaft of seed metering device to land wheel axle	:	Transmission ratio for seed metering mechanism is 0.73
	Type of agitator	:	Rubber agitator fitted on seed metering shaft
	Method of feed rate control for different sizes of seeds	:	By interchanging sprockets of power transmission system and various sizes on seed plates
	Provision for closing seed discharge.	:	A sliding type plate provided
	Fertilizer distributor	:	Fertilizer plate type distributor
4.4	**HOPPER:**		
	a) Capacity (kg)		
	1) Seed box	:	37 (Soybean)
	2) Fertilizer box	:	52 (DAP)
	b) Type of seed hoppers	:	Trapezoidal shape
	c) Type of fertilizer hoppers	:	Trapezoidal shape
4.5	**MARKER DETAILS:**	:	No provision is provided for marking
4.6	**SEED COVERING ARRANGEMENT**	:	Provided
4.7	**TYPE OF HITCH AND ITS DETAILS:**		
	Type	:	Three point linkage

Specification of Hitch Pyramid As per IS: 4468 -1997: -

S No.	Notation Specifications	Dimension (mm) As per IS	Dimension (mm) As measured	Remark
1	Upper Hitch Points -			
	Diameter of hitch pin hole	25.70-25.90	25.90	Conforms
	Width between inner surfaces of yoke	52.0 (Min)	52.91	Conforms
	Width between outer surfaces of yoke	86 (Max)	78.00	Conforms
2	**Lower Hitch point :**			
	Diameter of hitch pin	27.80 – 28.0	25.00	Does not conforms
	Diameter of hitch pin hole	28.7 – 29.0	26.25	Does not conforms
	Width between inner surfaces of yoke	52.0 (Min)	54.08	Conforms
	Width between outer surfaces of yoke	86 (Max)	86.00	Conforms
	Lower hitch point span	825 ±1.5	660	Does not conforms
3	Mast height	610±1.5	450	Does not conforms

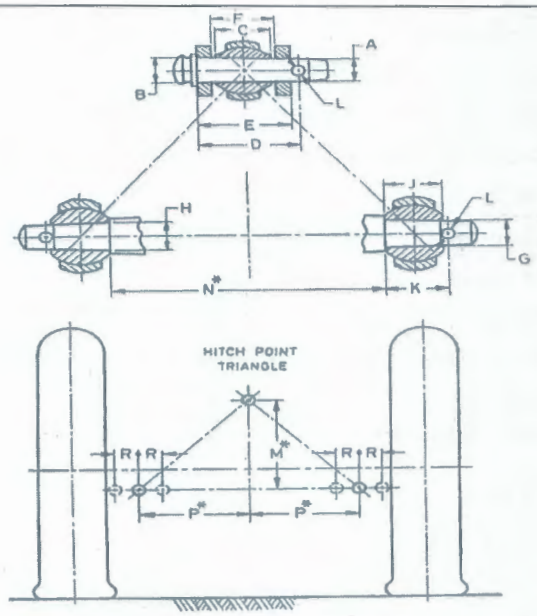

FIG. 1 · DIMENSIONS OF HITCH POINTS

Fig. 6 Specifications of the hitch pyramid

4.8	**GROUND DRIVE DETAILS:**		
	a) No. of wheel	:	One
	b) Type of wheel	:	Lugs on wheel (M.S.)
	c) Size (mm)	:	480 ϕ with lugs and 360 ϕ without lugs
	d) No. of lugs	:	12
	e) Method of transmitting power to feed shafts	:	Through chain and sprocket arrangement
4.9	**DETAILS OF ADJUSTMENTS:**		

Sl. No.	Adjustments		Method
1	Feed rate	:	Through various sizes of holes on seed plates and by interchanging sprocket in transmission system
2	Spacing of furrow openers	:	By means of adjusting tines
3	Depth of sowing	:	Through hydraulic system of tractor
4	Covering device	:	Covering device provided
5	Reduction ratio of drive mechanism	:	By interchanging drive and driven sprockets of drive wheel.

4.10	**Details of safety arrangement for rotating parts**	:	The guard is provided for chain and sprocket mechanism

4.11	**OVERALL DIMENSIONS (mm):**		
	a) Length	:	2465
	b) Width	:	1705
	c) Height	:	1130
	d) Weight with seeds and fertilizers (kg)	:	439
4.12	**Number of greasing points**	:	Four no of oil points instead of greasing points
4.13	**DETAILS OF MATERIAL OF CONSTRUCTION:**		

Sl. No.	Name of part	Material	Section or size
1	Feed shafts	MS	1750 mm in length and 20 mm ϕ in diameter
2	Seed and fertilizer box	MS	Length :1675mm (including partition box) Width : 355 mm at top and middle : 205 mm at bottom Height : 240 mm Thickness of sheet: 3 mm
3	Tyne	MS	810 mm (total curved length) x 25mm (T)
4	Boot	MS	20 mm ϕ (seed) and 35 mm ϕ (Fertilizer)
5	Seed tube	Nylon plastic	28.60 mm ϕ, 3 mm thickness of tube
6	fertilizer tube	Nylon plastic	27.80 mm ϕ, 2.50 mm thickness of tube
7	Covering device	MS	2295 mm (Length) x 50 mm (Width) x 8.2 (Thickness)

5. CONFORMITY TO INDIAN STANDARD

Clause	Performance requirement as per IS: 6813-2006	As observed	Remarks
1	2	3	4
5.1	**TYPE:** - For the purpose of this standard, the seed-cum-fertilizer drills should have the following types depending upon the source of power: a) Animal-drawn b) Tractor-operated: 1) Trailed, and 2) Mounted.	Tractor operated: Mounted type	Conforms
5.2	**SIZE:** The size of the drill shall be expressed by the number of seed furrow openers and the maximum spacing in millimeters between two adjacent furrow openers. For example, the size or drill, having 9 furrow openers and 225 mm row spacing, shall be 9x225.	7x380 (adjustable)	Conforms
5.3	**MATERIALS:** The materials for the construction of different components of the drill shall be selected from those given in Col 3 of Table 1. The materials should as far as possible conform to standards and grades as given in Col 4 and 5 of Table 1.		

Table No.1

S.No	Component	Material	Applicable Standard	Grade	As observed	Remarks
1	2	3	4	5	6	7
i)	Frame and tool bar	Mild Steel	IS 226:1975	---	Mild Steel	Conforms
ii)	Wheel	Mild steel	IS 226:1975	---	Mild Steel	Conforms
		Cast iron	IS 210:1978	FG 200		
		Pneumatic tyre	---	---		
iii)	Axle and Shaft	Mild Steel	IS 226:1975	---	Mild Steel	Conforms
iv)	Seed and fertilizer boxes	Mild Steel	IS 226:1975	---	Mild Steel	Conforms
		Galvanized sheet	IS 277:1985	---		
		Seasoned wood	IS 399:1963	---		
v)	Tines	Mild steel	IS 226:1975	---	Mild Steel	Conforms
		Carbon steel	IS 1570 (Part2/Sec2): 1988	C55Mn75		
vi)	Boot	Mild steel	IS 226:1975	---	Mild Steel	Conforms
		Cast Iron	IS 210:1978	FG200		
vii)	Furrow opener	High carbon steel	IS 1570 (Part 3): 1979	C75	Mild Steel	Does not conforms
viii)	Seed agitator	Mild steel	IS 226:1975	---	Rubber	Does not conforms
		Cast Iron	IS 210:1978	---		
		Aluminum	IS 617:1975	---		
ix)	Fertilizer agitator	Mild steel	IS 226:1975	---	Rubber	Does not conforms
		Cast iron	IS 210:1978	---		
		Aluminium	IS 617:1975	A-4M		
		Canvas	---	---		
x)	Seed and fertilizer tubes	Steel ribbon	---	---	Plastics	Conforms
		Plastics	---	---		
		Rubber	---	---		
xii)	Seed metering mechanism (plate type) seed feed roller	Rubber	--	--	Stainless steel	Does not Conforms
		Cast iron	IS 210	FG200		
		Mild steel	IS 2062	---		
xiii)	Fertilizer metering mechanism	Cast iron	IS 210:1978	FG200	Mild Steel	Conforms
		Mild steel	IS 226:1975	---		
		Cast Aluminium	IS 617:1975	---		
		Nylon	---	---		
xiv)	Bushes	Brass	IS 292:1983	3	Nylon	Conforms
		Gun metal	IS 306:1983	---		
		Nylon	---	---		
xv)	Covering device	Mild steel	IS 226:1975	---	Mild steel	Conforms
		Cast iron	IS 210:1978	FG200		
		Seasoned wood	IS 39:1963	---		
xvi)	Sprocket	Cast iron	IS 210:1978	FG200	Mild Steel	Conforms
		Mild steel	IS 226:1975	---		
xvii)	Hitching mechanism	Mild steel	Is 226:1975	---	Mild Steel	Conforms
xviii)	Feed adjusting mechanism	Mild steel	Is 226:1975	---	Mild Steel	Conforms
		Cast iron	IS 210:1978	FG200		
xix)	Depth adjusting mechanism	Mild steel	IS 226:1975	---	Not provided	Does not conforms
		Cast iron	IS 210:1978	FG200		
4	Row marker	Mild steel	IS 226:1975	---	Not Provided	Does not conforms
		Cast iron	IS 210	FG200		

5.4	**Hardness and chemical composition** test of furrow opener was carried out at Mattest Laboratory, Aurangabad details results are as given under.			
5.4.1	**Chemical analysis, %**	AS per IS: 1570 (part 3)	Observed	Conformity to IS
	Carbon	0.70-0.80	0.588	Does not conforms
	Silicon	-	0.28	-
	Manganese	0.5-0.8	1.23	Does not conforms
	Phosphorus	-	0.034	-
	Sulphur	-	0.022	-
5.4.2	**HARDNESS:** The furrow opener shall be hardened between 350 and 450 HB when tested in accordance with IS 1500:1983		203 HB (94 HRB)	Does not conforms
5.5	**CONSTRUCTIONAL REQUIREMENTS:**			
5.5.1	**Frame and toolbar:** - These should be rigid and strong. The toolbar should have 12.5 mm diameter holes after every 50 mm throughout its length.		Frame is rigid and strong.	Conforms
			The slot throughout the length of frame provided instead of holes	Does not conforms
5.5.2	Wheels should have either bushes or dust proof bearings. They should strong and shall be provided with lugs or pegs. Wheels should be so attached that they can be easily lowered or raised.		Wheel with bush & lugs have been provided. There is provision for lowering and raising	Conforms
5.5.3	**Axle and Shafts:** - Axles and shafts should be so attached that they can be removed for cleaning when desired.		It can be removed	Conforms
5.5.4	**Seed and fertilizer boxes: -**			
	a) These should be either separate or one continuous box with a partition.		One continuous box with a partition.	Conforms
	b) The boxes should have adequate capacity and may be of trapezoidal or cylindrical with or without tapered bottom.		The capacity of seed and fertilizer box is adequate and its shape is trapezoidal with tapered bottom	Conforms
	c) The boxes should be adequately covered to avoid entrance of water. The boxes should be sufficiently strong and should not buckle when fully filled with seed and fertilizer		Box is adequately covered and it is sufficiently strong.	Conforms

	d) The boxes should be provided with self-locking mechanism on being opened.	Provided	Conforms
	e) The thickness of mild steel and galvanized steel sheet for boxes shall be not less than 1.0 mm and 0.63 mm respectively.	M.S. sheet of 1.60 mm thickness is provided	Conforms
5.6	**Tines:** - Tines should be properly attached with tool bar either by bolts or clamps	Tines were properly attached with tool bar by nut bolts .	Conforms
5.6.1	**Furrow openers: -**		
	a) Furrow openers should be provided with depth adjustment arrangements.	No adjustment for depth	Does not conform
	b) There may be different furrow openers for seed and fertilizer or common for seed and fertilizer with the provision of dropping them separately.	There is common furrow opener for seed and fertilizer with separate dropping provision	Conforms
	c) Furrow openers of shovel, shoe or disc type shall conform to the requirements as given in Clause B-2.1.1. (IS-6813-2000)	Reversible shovel type and dimensions does not match.	Does not conforms
5.7	**Seed and Fertilizer Tubes:** - The tubes shall be of suitable length and shall be properly clamped with feed outlets of metering mechanism. There should not be any sharp bend in tubes. Tubes should be made of transparent plastic.	Seed and fertilizer tubes are made of transparent plastic with suitable length and properly clamped with feed outlets of metering mechanism	Conforms
5.7.1	The thickness of plastic tubes shall be 2.5mm minimum	The thickness of plastic tube is 3 mm	Conforms
5.8	**Metering Mechanisms**		
5.8.1	The seed metering mechanism components of fluted feed roller and plate type shall be in conformity to the requirements given in Annex. C. other types of seed metering mechanisms may also be used.	The seed plates are as per the clause C-2.1 of IS 6813-2000 and the dimensions are not fully matching.	Does not conforms
5.8.2	The fertilizer metering mechanism components, of fluted feed roller and plate type shall conform to the requirements as given in ANNEXURE-D	The fertilizer metering mechanism is plate type as per the clause D-2.1 of IS 6813-2000 and the dimensions are not matching.	Does not conforms

5.9	**Transmission System**		
	This may be sprocket and chain, belt and pulley, or gear type. Provisions for tightening of belt and adjustment of chains shall be provided.	Sprocket and chain type transmission system is provided.	Conforms
	Suitable clutches may be provided to stop the movement of metering mechanisms when the wheels are turned in reverse direction.	No such provision is made	Does not conforms
	The transmission system should be provided with a guard for safety.	Provided with guards	Conforms
5.10	**PERFORMANCE REQUIREMENTS**		
5.10.1	The variation in dropping of seed and fertilizer in different feeding outlets separately shall be not be more than 7 and 12.5 percent respectively from the average quantity obtained.	For soybean and green gram seed the variation in dropped seed at different setting in the range of -12.61 to 6.99 % and -16.15 to 7.00 %, respectively (Annexure-II, IV & VI) and for fertilizer it was in the range of -20.80 to 11.27 % (Annexure VIII & X)	Conforms
5.10.2	The seed and fertilizer rate shall easily adjustable up to 125 kg and 1000 kg per hectare respectively.	Adjustment provided. Seed rate can be adjusted up to 161. 40 kg/ha where as fertilizer rate up to 287.06 kg/ha	Conforms for seed rate only.
5.10.3	The percentage of visible damage to seed in the drill shall not exceed 0.5 percent.	For soybean and green gram crop the maximum visible damage was observed 0.46 % and 0.45 %, respectively.	Conforms
5.10.4	The variation in quantity of seed per meter of row length shall not exceed by 10 percent.	The maximum variation in quantity of seed per five meter row length was observed as 5.15 % (max.) in respect of soybean seed	Conforms

5.10.5	The drill shall be able to sow seed up to 100 mm deep and should be able to drop fertilizer at a minimum of 25 mm to the side of the seed	Able to sow up to 100 mm depth and fertilizer drop at top side of the seed near about 25 mm.	Conforms
5.10.6	The wheel slip at specified speed shall not exceed by 15 percent.	The maximum wheel slippage was observed as 9.84 %	Conforms
5.10.8	The drill shall be able to sow wheat and one or more of the following seeds: Barley, Paddy, Millet, Pea, Bengal gram, Soybean, and Pigeonpea. The drill shall also be able to sow all types of granular fertilizers.	The seed cum ferti. drill tested for green gram, soybean and fertilizer.	Conforms
5.11	**OTHER REQUIREMENTS**		
5.11.1	Tractor-operated drill shall have 5 to 15 furrow openers.	The drill has seven furrow opener	Conforms
5.11.2	The row spacing shall be adjustable, ranging from 150 to 225 mm, preferably in steps of 25 mm.	Adjustable for the adjustment slot provided throughout length of the frame	Conforms
5.11.3	When the furrow openers are lowered to plain surface, the openers shall not deviate by more than 5 mm from the line of alignment vertically and horizontally.	1.2 mm from the line of alignment horizontally	Conforms
5.11.4	The weight of tractor-mounted drill including the weight of seed and fertilizer filled at rated capacity of box shall not exceed 300 N/kW drawbar power of the tractor recommended for the drill.	190.05 N/kW was observed.	Conforms
5.11.5	A permanent type metallic calibration plate indicating the metering position and quantity of seed and fertilizer shall be attached under the top cover of seed box.	Calibration marking provided	Conform
5.11.6	In case of all the trailed drills and mounted drills having plate type metering mechanism, arrangement for quick cut-off of the seed and fertilizer when the seed drill is moving, should be provided. This arrangement should be without disturbing the setting of metering mechanism.	NA	---

5.11.7	Proper lubrication arrangements should be provided for all moving components except the portions exposed to seed and fertilizer.	Provided	conforms
5.11.8	For tractor-operated drills the system of hitching should be designed to suit the three-point linkage and drawbar of agricultural tractors (see IS 4468:1986 and IS 4931:1984).	Referred in 4.7	--
5.11.9	Each drill shall be provided with instruction sheets containing full information on method of operation and installation of the drill.	Provided	Conforms
5.11.9.1	Each drill shall also be supplied with necessary tools.	Provided	Conforms
5.11.9.2	Provision should be made for easy removal of seed and fertilizer from the hoppers after the days work.	Not provided	Does not Conforms
5.11.9.3	Each drill shall be provided with manual containing maintenance and storage instructions, calibration chart, etc.	Provided	Conforms
5.12	**ACCESSORIES**		
	The following accessories may be provided with each drill:		
	a) Foot board	Not provided	Does not conforms
	b) Covering device,	Provided	Conforms
	c) Row marker,	Not provided	Does not conforms
	d) Press wheel, and	Not provided	Does not conforms
	e) Area recorder.	Not provided	Does not conforms
5.13	**WORKMAN SHIP AND FINISH: -**		
5.13.1	The welding shall be satisfactory in all respects and should not be brittle or porous.	Satisfactory	Conforms
5.13.2	The components shall be free from rust and shall have a protective coating to prevent surface deterioration in transit and storage.	Satisfactory	Conforms
5.13.3	The components should be free from pits, burrs and other defects that may be detrimental for their use.	Satisfactory	Conforms
5.14	**MARKING AND PACKING: -**		
5.14.1	**Marking:** - Each drill shall be marked with the following particulars:		
	Indication of the source of manufacture	Marked	Conform

	Model. code and serial number; and	Not marked	Does not conforms
	Type and size.	Not marked	Does not conforms
	Type of seed (suitability) and	Not marked	Does not conforms
	Mass	Not marked	Does not conforms
5.14.2	The product may also be marked with the BIS Standard Mark.	NA	---
5.14.3	**Packing:** - Packing of the drill and its components should be done as agreed to between the purchaser and the supplier to avoid damage in transit.	NA	---

6. RUNNING -IN :

The machine was run-in at this Institute for 0.5 hour as per the instructions and recommendations of the applicant's representative.

7. LABORATORY TEST

7.1 Metering:

7.1.1 Calibration:

The calibration of seed drill in the laboratory was carried out for soybean & green gram seeds and fertilizer at full, three-fourth, one-half and one-fourth capacity of the hopper and at maximum, optimum and minimum feed rates after best possible adjustments made by the manufacturer's representative. The details of the tests are given in **Annexure-I, II, III, IV, V, VI, VII, VIII, IX, X, XI** and **Annexure –XII** and are summarized in **Table No. 2, Table No. 3 and Table No.4** respectively.

Table No.2

Sl. No.	Hopper capacity/ Feed rate	Avg. weight of seeds collected from furrow openers (gm) at speed		Avg. Seed Rate (kg/ha) at speed		Mechanical damage,%, Avg.
		3.5 km/h	4.5 km/h	3.5 km/h	4.5 km/h	
A.	**Soybean**					
1	**Full capacity**					
i)	Max	289.93	344.42	130.80	120.85	0.28
ii)	Optimum	226.00	273.53	101.95	95.98	0.28
iii)	Min.	140.63	170.52	63.44	59.83	0.28

2	**3/4th capacity**					
i)	Max.	283.20	326.32	127.76	114.50	0.33
ii)	Optimum	230.19	249.89	103.84	87.68	0.21
iii)	Min.	141.96	163.50	64.04	57.37	0.34
3.	**1/2 capacity**					
i)	Max.	290.85	328.85	131.21	115.38	0.30
ii)	Optimum	241.30	264.36	139.96	92.76	0.20
iii)	Min.	136.07	165.28	61.39	57.99	0.34
4.	**1/4th capacity**					
i)	Max.	278.27	319.92	161.40	112.25	0.33
ii)	Optimum	214.16	242.75	96.61	85.17	0.28
iii)	Min.	129.36	152.41	58.36	53.48	0.29

Table No. 3

Sl. No.	Hopper capacity/ Feed rate	Avg. weight of seeds collected from furrow openers (gm) at speed		Avg. Seed Rate (kg/ha) at speed		Mechanical damage, %, Avg.
		3.5 km/h	4.5 km/h	3.5 km/h	4.5 km/h	
A.	**Green gram :**					
1	**Full capacity**					
i)	Max	81.81	89.25	36.91	31.31	0.27
ii)	Optimum	42.21	46.27	19.04	16.23	0.29
iii)	Min.	25.60	27.15	11.55	9.53	0.34
2	**3/4th capacity**					
i)	Max.	74.87	90.99	33.78	31.93	0.26
ii)	Optimum	41.19	46.37	18.58	16.27	0.29
iii)	Min.	22.23	25.72	12.90	9.03	0.30
3.	**1/2 capacity**					
i)	Max.	79.06	93.27	35.67	32.73	0.27
ii)	Optimum	40.48	46.46	18.26	16.30	0.26
iii)	Min.	18.80	46.46	8.48	16.30	0.27

4.	1/4th capacity					
i)	Max.	67.54	84.51	30.47	29.65	0.28
ii)	Optimum	34.01	43.02	15.34	15.09	0.29
iii)	Min.	18.45	23.72	8.33	8.32	0.25

Table No. 4

Sl. No.	Hopper capacity/ Feed rate	Avg. weight of fertilizer collected from furrow openers (gm) at speed		Avg. Seed Rate (kg/ha)at speed	
		3 .5 km/h	4.5 km/h	3.5 km/h	4.5km/h
1	2	3	4	5	6
A.	Fertilizer: Rotor				
1	Full capacity				
i)	Max.	539.15	686.58	243.23	240.91
ii)	Optimum	223.47	404.44	100.81	141.91
iii)	Min	131.38	142.79	59.27	50.10
2	3/4th capacity				
i)	Max.	631.82	607.34	285.03	213.10
ii)	Optimum	222.65	409.79	100.44	143.79
iii)	Min.	126.61	141.11	57.12	49.51
3.	1/2capacity				
i)	Max.	636.31	579.80	287.06	203.44
ii)	Optimum .	224.91	394.60	101.46	138.45
iii)	Min.	133.83	142.45	60.38	49.98
4.	1/4th capacity				
i)	Max.	560.59	560.99	252.90	196.84
ii)	Optimum	216.96	364.97	97.88	128.06
iii)	Min.	126.05	137.52	56.86	48.25

7.1.2 Mechanical Damage: -

The analysis for the visible damage to the seeds of soybean and green gram was carried out by counting and weighing the damage seeds from 100gram sample collected from each furrow opener. The mechanical damage of the seed before test was nil. The analysis was carried out full, three-fourth, one-half and one-fourth capacity of the hopper and at maximum, optimum and minimum feed rates after best possible adjustments made by the

manufacturer's representative. The details of the tests are given in **Annexure-XIII and XIV** are summarized in Table No.2 and Table No.3

7.1.3 Seeding Uniformity:

The facility for conducting the seeding uniformity test by Sticky Belt Method does not exist at this Institute; hence Sand Bed Method is used to ensure the uniformity in metering. The Seeding Uniformity Test for soybean was conducted on well-prepared sand bed of 5 m length and the width is equal to that of implement's width. The seed drill was operated over this bed with seed tube very near to the top surface of the bed. The number of seeds fallen and average distance between two seeds was measured in a strip of five-meter length from each furrow opener in optimum feed rate setting. The details of the results are given in Annexure-XV and summarized in Table-5.

Table No.5

Test No.	No. of seed fallen in furrow openers in 5 m length	Range of distance between two seed in furrow openers
I	703	1.56-2.45
II	708	1.89-2.54
III	712	1.37-2.87

7.1.4 Wear analysis: -

The wear percentage of soil engaging furrow opener after operating in field for 28.94 hr is shown in following table. The weight of furrow opener was taken along with boot

Shovel No.	Initial Mass (g)	Final Mass (g)	Percentage Wear	
			Total	Per hour
1	826	820	0.726	0.025
2	828	823	0.604	0.021
3	824	821	0.364	0.013
4	825	822	0.364	0.013
5	828	825	0.362	0.013
6	827	820	0.846	0.029
7	826	823	0.363	0.013

8. FIELD TESTS

8.1 Field calibration: -

The field calibration of seed drill was conducted for soybean and green gram. following the same procedure as that of laboratory calibration (**7.1.1**), except the

drill was operated in the well-prepared seedbed by mounting with the tractor. The details of the test results are given in **Annexure-XVI & XVII** and summarized in **Table No. 6.**

8.2 **Field operation: -**

The seed cum fertilizer drill was operated for 28.94 hours at the Institute's Farm and farmer field for soybean and green gram under varying soil and moisture conditions in well-prepared seedbed. The details of test results are given in **Annexure-XVI & XVII** and are summarized in **Table No.6.**

Table No. 6
SUMMARY OF FIELD PERFORMANCE TEST

S. No.	Parameters	Soybean	Green gram
1	Type of soil	Medium black soil	Medium black soil
2	Av. soil moisture (%)	12.88-14.71	12.52-14.87
3	Av. Speed of operation (kmph)	3.00-3.49	3.21-3.41
4	Av. wheel slippage (%)	7.37-8.61	6.41-6.34
5	Row spacing (cm)	38.00	38.00
6	Average depth of sowing (cm):		
	-Seed	5.66-6.38	6.12-6.34
	-Fertilizer	4.52-5.08	4.94-5.12
7	Av. Width of sowing (cm)	266.00	266.00
8	Area covered (ha/h)	0.550-0.623	0.56-0.602
9	Time required for 1 ha (h)	1.61-1.82	1.66-1.78
10	Seed rate (kg/ha)	80.70-82.20	18.50-20.10
11	Fertilizer rate (kg/ha)	111.80-115.10	111.90-114.40
12	Field efficiency (%)	67.1-69.51	61.85-70.00
13	Av. Implement draft (kgf)	499-527	520-535
14	Power requirement, (kW)	4.35-5.08	4.71-5.01
15	Fuel consumption:		
	-l/h	3.57-3.66	3.60-3.65
	-l/ha	5.8-6.66	6.01-6.51

8.2.1 **Rate of work: -**

The average working width of sowing was observed as 266 cm in both crop soybean and green gram . The area covered was found to be in the range of 0.550-0.623 ha/h in soybean and 0.56-0.602 ha/h for green gram , respectively.

8.2.2 **Quality of work: -**

The depth of placement of seed was observed in the range of 5.66-6.38 cm for soybean and 6.12-6.34 cm for green gram , respectively.

8.2.3 Field efficiency:

Field efficiency of the machine was observed in the range of 67.1-69.51 % for soybean and 61.85-70.00 % for green gram, respectively.

8.2.4 Power requirement:

The draft and power requirement for seed drill was found in the range of 499-527 kg in and 4.35-5.08 kW in soybean field, respectively. The draft and power requirement for the implement was found in the range of 520-535 kg and 4.71-5.01kW in green gram field, respectively.

8.2.5 Labour requirement: -

One skilled operator is needed to operate the tractor and the other person is needed for filling the seed box to check furrow openers and seed tubes against choking.

9 EASE OF OPERATION AND ADJUSTMENTS: -

Seed sum fertilizer drill was easy to adjust and operate with tractor at recommended power. The maneuverability of the tractor and seed cum fertilizer drill is considered satisfactory.

10. DEFECTS, BREAK DOWNS AND REPAIRS

No breakdown occurred during of operation of seed drill.

11. SUMMARY OF OBSERVATIONS, COMMENTS AND RECOMMENDATIONS

11.1	The dimension of the furrow openers does not conform fully to the requirement as per relevant IS. This should be modified accordingly.
11.2	The dimensions of the seed metering mechanisms and fertilizer metering mechanism do not conform fully to the requirement as per relevant IS. Suitable improvements should be done.
11.3	The specification of three-point linkage does not fully conform with IS: 4468-1997ane this should be looked into matter.
11.4	The accessories like footboard, row marker, press wheel and area recorder is not provided with the machine. These may be provided as per requirement as per relevant IS.
11.5	Covering device provided with machine however row marker should be provided along with seed cum ferti. drill.
11.6	The labelling plate of machine does not conform fully to the requirement of IS 6813:2000 (Reaffirmed Dec. 2004) and may be improved.
11.7	The material of furrow opener was observed mild steel. It should be carbon steel as per IS 1570 (Part 3): 1979.
11.8	The hardness of the furrow openers was recorded as 203 HB against 350-450 HB as per IS: 1500-1983, which is on lower side. This should be strictly looked in to matter.
11.9	The carbon content of furrow opener is in lower side and Manganese is an higher side

	hence it needs improvement.
11.10	The fertilizer rate is adjustable up to 287 kg/ha, against the requirement of 1000 kg/ha. This should be modified.
11.11	The suitable clutches are not provided to stop the movement of metering mechanisms when the wheels are in reverse direction. Suitable changes be provided.
11.12	Provision should be made for easy removal of seed and fertilizer from the hoppers after the days work.
11.13	The slot is provided on main frame throughout length on the main frame, against the requirement of 50 mm as per the Indian standard.
11.14	The necessary tools were not supplied during the submission of machine; hence it is recommended that the drill should be supplied with necessary tools before delivery of machine.
11.15	Vide शासन निर्णय क्र.– 418/प्र क 155/14 ए, दिनांक 27/04/2018, it is mandatory to emboss the report No. i.e. Dr. PDKV / Tractor Drawn / Seed cum Ferti. Drill /IMP-TR-62/136 / 2018 on every seed cum ferti. drill during its mass production.
11.16	Vide letter No. 13-24/2018-M&T (I&P), dated 19th September 2018 Govt. of India, Ministry of Agriculture and Farmer Welfare (Mechanization & Technology Division), the validity of the commercial test report of tractor operated machinery is 7 years.
11.17	It is the sole responsibility of manufacturer to supply the quality machine same as the test prototype provided including suggested modifications, comments and recommendation.

TESTING AUTHORITY

Er. U. S. Kankal **Test Engineer**	
Dr. A.K. Kamble **Principal Investigator**	
Dr. S. H. Thakare **Head, Deptt. of FPM**	

Test report is compiled by Er. U. S. Kankal

12 APPLICANT'S COMMENTS

M/S Sandeep Agro Works, Akot is ready to incorporate all comments which is mentioned in clause no. 11.11 to 11.17

ANNEXURE-I
STATIONERY CALIBRATION FOR SOYBEAN

Date: 3/02/2018 Forward speed: 3.5 km h
Type of seed: Soybean Variety of seed: JS-9305

Level of seed in hopper	Rate setting	Average weight of seed in (gm) from furrow openers								Seed rate, kg/ha
		No.1	No.2	No.3	No.4	No.5	No.6	No.7	Avg.	
1	2	3	4	5	6	7	8	9	10	11
Full	Max	277.84	271.24	276.85	284.4	311.49	302.6	305.12	289 93	130.80
	Optimum	210.2	217.3	231.35	223.4	235	231.25	233.5	226 00	101.95
	Min	144.57	145.12	135.92	139.1	143.42	135	141.3	140.63	63.44
3/4th	Max	273.57	265.13	283.6	286.6	297.85	291.25	284.42	283 20	127 76
	Optimum	226.9	226.34	224.7	233.92	232.97	235.16	231.32	230 19	103 84
	Min	137.42	138.18	147.3	135.36	151.94	146.29	137.23	141 96	64.04
2-Jan	Max	289.78	275.46	286.99	288.71	302.1	307.9	284.98	290.85	131 21
	Optimum	241.21	230.02	232.83	239.07	249.28	250.76	245.9	241 30	139 96
	Min	134.81	128.65	135.06	132.2	142.67	143.99	135.13	136.07	61.39
1/4th	Max	269.64	269.72	276.58	282.03	283.42	279.9	286.57	278.27	161 40
	Optimum	203.08	203.18	219.41	215.26	233.3	211.43	213.48	214.16	96.61
	Min	125.32	125.52	122.85	127.73	134.84	138.26	130.98	129.36	58.36

ANNEXURE-II
VARIATTION FROM MEAN IN STATIONERY CALIBRATION FOR SOYBEAN

Date: 3/02/2018 Forward speed: 3.5 km h
Type of seed: Soybean Variety of seed: JS-9305

Level of seed in hopper	Rate setting	Variation from mean, percent						
		No.1	No.2	No.3	No.4	No.5	No.6	No.7
1	2	3	4	5	6	7	8	9
Full	Max	4.17	6.45	4.51	1.91	-7.43	-4.37	-5.24
	Optimum	6.99	3.85	-2.37	1.15	-3.98	-2.32	-3.32
	Min	-2.80	-3.19	3.35	1.09	-1.98	4.01	-0.47
3/4th	Max	3.40	6.38	-0.14	-1.20	-5.17	-2.84	-0.43
	Optimum	1.43	1.67	2.38	-1.62	-1.21	-2.16	-0.49
	Min	3.20	2.66	-3.76	4.65	-7.03	-3.05	3.33
1/2	Max	0.37	5.29	1.33	0.73	-3.87	-5.86	2.02
	Optimum	0.04	4.67	3.51	0.92	-3.31	-3.92	-1.91
	Min	0.93	5.46	0.74	2.85	-4.85	-5.82	0.69
1/4th	Max	3.10	3.07	0.61	-1.35	-1.85	-0.59	-2 98
	Optimum	5.17	5.13	-2.45	-0.51	-8.94	1.28	0.32
	Min	3.12	2.97	5.03	1.26	-4.24	-6.88	-1.25

ANNEXURE-III
STATIONERY CALIBRATION FOR SOYBEAN

Date: 5/02/2018 Forward Speed: 4.5 km/h

Type of seed : Soybean Variety of seed: JS-9305

Level of seed in hopper	Rate setting	Average weight of seed in (gm) from furrow openers								Seed rate in kg/ha
		No.1	No.2	No.3	No.4	No.5	No.6	No.7	Avg.	
1	2	3	4	5	6	7	8	9	10	11
Full	Max	335.13	329.35	329.52	387.84	344.52	343.34	341.23	344.42	120.85
	Opt.	269.89	257.83	276.44	271.86	285.95	276.69	276.06	273.53	95.98
	Min	172.5	159.61	172.17	164.26	170.27	180.14	174.7	170.52	59.83
3/4th	Max	323.94	315.3	323.22	331.67	333.76	327.08	329.28	326.32	114.50
	Opt.	250.77	239.22	250.55	252.33	249.08	252.61	254.64	249.89	87.68
	Min	165.68	154.84	163.08	164.44	166.18	161.83	168.43	163.50	57.37
1/2	Max	323.06	310.24	321.64	333.06	342.45	336.76	334.71	328.85	115.38
	Opt.	268.3	248.14	259.6	258.84	272.67	265.34	277.64	264.36	92.76
	Min	160.03	160.6	160.36	163.03	164.18	169.97	178.82	165.28	57.99
1/4th	Max	302.53	301.57	312.08	331.79	329.49	322.13	339.83	319.92	112.25
	Opt.	234.6	229.25	237.78	245.98	242.4	250.14	259.08	242.75	85.17
	Min	147.55	145.13	154.32	150.54	156.83	151.84	160.68	152.41	53.48

ANNEXURE-IV
VARIATTION FROM MEAN IN STATIONERY CALIBRATION FOR SOYBEAN

Date: 5/02/2018 Forward Speed: 4.5 km/h

Type of seed : Soybean Variety of seed: JS-9305

Level of seed in hopper	Rate setting	Variation from mean , percent						
		No.1	No.2	No.3	No.4	No.5	No.6	No.7
1	2	3	4	5	6	7	8	9
Full	Max	2.70	4.38	4.33	-12.61	-0.03	0.31	0.93
	Opt.	1.33	5.74	-1.06	0.61	-4.54	-1.15	-0.92
	Min	-1.16	6.40	-0.97	3.67	0.15	-5.64	-2.45
3/4th	Max	0.73	3.38	0.95	-1.64	-2.28	-0.23	-0.91
	Opt.	-0.35	4.27	-0.27	-0.98	0.32	-1.09	-1.90
	Min	-1.34	5.29	0.26	-0.58	-1.64	1.02	-3.02
1/2	Max	1.76	5.66	2.19	-1.28	-4.14	-2.41	-1.78
	Opt.	-1.49	6.14	1.80	2.09	-3.14	-0.37	-5.02
	Min	3.18	2.83	2.98	1.36	0.67	-2.83	-8.19
1/4th	Max	5.43	5.73	2.45	-3.71	-2.99	-0.69	-6.22
	Opt.	3.36	5.56	2.05	-1.33	0.14	-3.05	-6.73
	Min	3.19	4.78	-1.25	1.23	-2.90	0.38	-5.42

ANNEXURE-V
STATIONERY CALIBRATION FOR GREEN GRAM

Date: 7/02/2018 Forward speed: 3.5 km/h
Type of seed: Green gram Variety of seed : PKV-AKM-4

Level of seed in hopper	Rate setting	Average weight of seed in (gm) from furrow openers								Seed rate in kg/ha
		No.1	No.2	No.3	No.4	No.5	No.6	No.7	Average	
1	2	3	4	5	6	7	8	9	10	11
Full	Max	90.74	82.94	76.46	79.76	83.23	79.34	80.23	81.814	36.91
	Optimum	43.34	41.26	39.4	43.05	40.34	45.76	42.34	42.213	19.04
	Min	24.26	24.76	24.68	29.83	25.57	25.46	24.64	25.600	11.55
3/4th	Max	80.79	75.8	71.53	76.36	73.45	74.32	71.85	74.871	33.78
	Optimum	43.16	39.29	38.32	43.24	42.45	39.45	42.43	41.191	18.58
	Min	24.97	21.61	21.79	22.05	21.34	21.43	22.45	22.234	12.90
1/2	Max	81.08	78.16	74.61	78.36	79.23	80.34	81.64	79.060	35.67
	Optimum	43.33	40.5	38.04	40.31	39.57	40.32	41.3	40.481	18.26
	Min	20.95	17.8	18.6	19.01	18.35	19.32	17.54	18.796	8.48
1/4th	Max	71.97	64.21	64.35	67.5	68.32	67.21	69.21	67.539	30.47
	Optimum	37.7	32.66	32.44	35.48	33.23	32.45	34.12	34.011	15.34
	Min	19.68	17.5	17.17	19.8	19.34	17.35	18.34	18.454	8.32

ANNEXURE-VI
VARIATTION FROM MEAN IN STATIONERY CALIBRATION FOR GREEN GRAM

Date: 7/02/2014 Forward speed: 3.5 km/h
Type of seed: Green gram Variety of seed: PKV-AKM-4

Level of seed in hopper	Rate setting	Variation from mean , percent						
		No.1	No.2	No.3	No.4	No.5	No.6	No.7
1	2	3	4	5	6	7	8	9
Full	Max	-10.91	-1.38	6.54	2.51	-1.73	3.02	1.94
	Optimum	-2.67	2.26	6.66	-1.98	4.44	-8.40	-0.30
	Min	5.23	3.28	3.59	-16.52	0.12	0.55	3.75
3/4th	Max	-7.90	-1.24	4.46	-1.99	1.90	0.74	4.04
	Optimum	-4.78	4.62	6.97	-4.97	-3.06	4.23	-3.01
	Min	-12.30	2.81	2.00	0.83	4.02	3.62	-0.97
1/2	Max	-2.56	1.14	5.63	0.89	-0.22	-1.62	-3.26
	Optimum	-7.04	-0.05	6.03	0.42	2.25	0.40	-2.02
	Min	-11.46	5.30	1.04	-1.14	2.37	-2.79	6.68
1/4th	Max	-6.56	4.93	4.72	0.06	-1.16	0.49	-2.47
	Optimum	-10.85	3.97	4.62	-4.32	2.30	4.59	-0.32
	Min	-6.64	5.17	6.96	-7.29	-4.80	5.98	0.62

ANNEXURE-VII
STATIONERY CALIBRATION FOR GREEN GRAM

Date: 7/02/2018 Forward speed: 4.5 km/h
Type of seed: Green gram Variety of seed: PKV-AKM-4

Level of seed in hopper	Rate setting	Average weight of seed in (gm) from furrow openers								Seed rate, kg/ha
		No.1	No.2	No.3	No.4	No.5	No.6	No.7	Average	
1	2	3	4	5	6	7	8	9	12	13
Full	Max	86.86	89.88	87.1	91.66	92.54	88.32	88.36	89.25	31.31
	Optimum	49.13	48.04	43.64	44.69	49.32	43.85	45.21	46.27	16.23
	Min	26.69	29.18	25.48	26.52	27.23	28.29	26.64	27.15	9.53
3/4th	Max	96.2	93.26	88.39	89.93	90.43	88.32	90.43	90.99	31.93
	Optimum	52.26	49.13	43.89	43.27	45.67	46.86	43.53	46.37	16.27
	Min	26.65	27.03	23.9	24.86	25.86	27.86	23.9	25.72	9.03
1/2	Max	97.92	95.9	91.79	91.56	89.65	92.64	93.42	93.27	32.73
	Optimum	49	46.86	45.74	46.97	43.97	45.97	46.74	46.46	16.30
	Min	27.69	26.65	21.7	22.96	23.9	25.76	25.74	46.46	16.30
1/4th	Max	84.9	85.9	81.8	82.76	83.96	86.83	85.42	84.51	29.65
	Optimum	42.98	43.58	40.48	40.95	41.65	45.25	46.25	43.02	15.09
	Min	24.04	24.46	22.95	22.45	23.74	24.75	23.64	23.72	8.32

ANNEXURE-VIII
VARIATTION FROM MEAN IN STATIONERY CALIBRATION FOR GREEN GRAM

Date:7/02/2018 Forward speed: 4.5 km/h
Type of seed :Green gram Variety of seed: PKV-AKM-4

Level of seed in hopper	Rate setting	Variation from mean , percent						
		No.1	No.2	No.3	No.4	No.5	No.6	No.7
1	2	3	4	5	6	7	8	9
Full	Max	2.67	-0.71	2.40	-2.71	-3.69	1.04	0.99
	Optimum	-6.18	-3.83	5.68	3.41	-6.60	5.23	2.29
	Min	1.68	-7.49	6.14	2.31	-0.31	-4.21	1.87
3/4th	Max	-5.72	-2.49	2.86	1.17	0.62	2.94	0.62
	Optimum	-12.70	-5.95	5.35	6.69	1.52	-1.05	6.13
	Min	-3.60	-5.08	7.09	3.35	-0.53	-8.31	7.09
1/2	Max	-4.99	-2.82	1.59	1.83	3.88	0.67	-0.16
	Optimum	-5.46	-0.85	1.56	-1.09	5.37	1.06	-0.59
	Min	-5.46	-0.85	1.56	-1.09	5.37	1.06	-0.59
1/4th	Max	-0.46	-1.64	3.21	2.07	0.65	-2.75	-1.08
	Optimum	0.09	-1.30	5.90	4.81	3.18	-5.18	-7.51
	Min	-1.36	-3.13	3.24	5.35	-0.09	-4.35	0.33

ANNEXURE-IX
STATIONERY CALIBRATION FOR (FERTILIZER DAP)

Date: 8/02/2018 Forward speed: 3.5 km/h

Type of fertilizer: DAP

Level of seed in hopper	Rate setting	Average weight of fertilizer in (gm) from furrow openers								Seed rate, kg/ha
		No.1	No.2	No.3	No.4	No.5	No.6	No.7	Average	
1	2	3	4	5	6	7	8	9	12	13
Full	Max	512.82	547.35	509.65	550.56	532.56	571.24	549.89	539.15	243.23
	Optimum	214.98	231.46	205.89	226.12	215.25	240.68	229.89	223.47	100.81
	Min	138.99	128.63	119.58	129.77	137.18	138.02	127.5	131.38	59.27
3/4th	Max	565.33	710.63	566.75	710.26	578.54	721.9	569.32	631.82	285.03
	Optimum	216.86	225.15	206.73	220.22	216.96	242.28	230.32	222.65	100.44
	Min	114.5	128.81	116.64	121.78	131.99	143.46	129.11	126.61	57.12
1/2	Max	575.89	565.78	681.18	648.75	656.92	679.94	645.7	636.31	287.06
	Optimum	215.71	229.02	202.56	232.94	219.61	246.63	227.89	224.91	101.46
	Min	120.91	139.09	119.34	134.58	138.74	153.14	131.03	133.83	60.38
1/4th	Max	507.51	541.5	566.64	582.05	512.99	677.21	536.24	560.59	252.90
	Optimum	197.58	217.12	193.05	213.64	230.16	233.09	234.08	216.96	97.88
	Min	116.06	129.58	111.85	129.11	130.41	139.84	125.5	126.05	56.86

ANNEXURE-X
VARIATTION FROM MEAN IN STATIONERY CALIBRATION (FERTILIZER DAP)

Date:8/02/2018 Forward speed: 3.5 km/h

Type of fertilizer: DAP

Level of fertilizer in hopper	Rate setting	Variation from mean ,percent						
		No.1	No.2	No.3	No.4	No.5	No.6	No.7
1	2	3	4	5	6	7	8	9
Full	Max	4.88	-1.52	5.47	-2.12	1.22	-5.95	-1.99
	Optimum	3.80	-3.58	7.87	-1.19	3.68	-7.70	-2.87
	Min	-5.79	2.09	8.98	1.23	-4.41	-5.05	2.95
3/4th	Max	10.52	-12.47	10.30	-12.42	8.43	-14.26	9.89
	Optimum	2.60	-1.12	7.15	1.09	2.55	-8.82	-3.45
	Min	9.57	-1.74	7.88	3.82	-4.25	-13.31	-1.97
1/2	Max	9.50	11.08	-7.05	-1.96	-3.24	-6.86	-1.48
	Optimum	4.09	-1.83	9.94	-3.57	2.36	-9.66	-1.33
	Min	9.66	-3.93	10.83	-0.56	-3.67	-14.43	2.09
1/4th	Max	9.47	3.41	-1.08	-3.83	8.49	-20.80	4.34
	Optimum	8.93	-0.07	11.02	1.53	-6.08	-7.43	-7.89
	Min	7.93	-2.80	11.27	-2.43	-3.46	-10.94	0.44

ANNEXURE-XI
STATIONERY CALIBRATION FOR (FERTILIZER DAP)

Date: 9/02/2018 Forward speed: 4.5 km/h

Type of fertilizer: DAP

Level of seed in hopper	Rate setting	Average weight of fertilizer in (gm) from furrow openers								Seed rate, kg/ha
		No.1	No.2	No.3	No.4	No.5	No.6	No.7	Average	
1	2	3	4	5	6	7	8	9	12	13
Full	Max	609.34	650.6	694.94	713.21	626.47	746.4	765.1	686.58	240.91
	Optimum	387.07	401.73	420.08	416.85	440.66	378.56	386.1	404.44	141.91
	Min	136.39	141.35	145.92	138.54	142.84	148.45	146.06	142.79	50.10
3/4th	Max	598.02	575.5	571.98	607.71	582.22	668.4	647.55	607.34	213.10
	Optimum	398.46	426.16	372.33	399.39	466.34	403.76	402.11	409.79	143.79
	Min	141.99	149.81	127.47	132.93	138.86	150.7	145.99	141.11	49.51
1/2	Max	542.04	550.1	572.15	589.56	569.76	601.66	633.34	579.80	203.44
	Optimum	382.81	402.55	366.35	393.44	399.45	409.18	408.39	394.60	138.45
	Min	143.61	146.59	132.85	132.03	145.72	151.64	144.7	142.45	49.98
1/4th	Max	499.35	619.17	534.86	532.76	564.84	582.21	593.76	560.99	196.84
	Optimum	339.99	341.25	329.1	391.88	388.85	385.96	377.74	364.97	128.06
	Min	135.46	139.68	121.89	125.97	147.94	143.11	148.62	137.52	48.25

ANNEXURE-XII
VARIATTION FROM MEAN IN STATIONERY CALIBRATION FOR (FERTILIZER DAP)

Date: 9/02/2018 Forward speed: 4.5 km/h

Type of fertilizer: DAP

Level of fertilizer in hopper	Rate setting	Variation from mean ,percent						
		No.1	No.2	No.3	No.4	No.5	No.6	No.7
1	2	3	4	5	6	7	8	9
Full	Max	11.25	5.24	-1.22	-3.88	8.75	-8.71	-11.44
	Optimum	4.29	0.67	-3.87	-3.07	-8.96	6.40	4.53
	Min	4.48	1.01	-2.19	2.98	-0.03	-3.96	-2.29
3/4th	Max	1.53	5.24	5.82	-0.06	4.14	-10.05	-6.62
	Optimum	2.77	-3.99	9.14	2.54	-13.80	1.47	1.87
	Min	-0.63	-6.17	9.66	5.79	1.59	-6.80	-3.46
1/2	Max	6.51	5.12	1.32	-1.68	1.73	-3.77	-9.23
	Optimum	2.99	-2.02	7.16	0.29	-1.23	-3.70	-3.50
	Min	-0.82	-2.91	6.74	7.31	-2.30	-6.45	-1.58
1/4th	Max	10.99	-10.37	4.66	5.03	-0.69	-3.78	-5.84
	Optimum	6.84	6.50	9.83	-7.37	-6.54	-5.75	-3.50
	Min	1.50	-1.57	11.37	8.40	-7.57	-4.06	-8.07

ANNEXURE-XIII

Date: 15/02/2018 Variety of seed: JS-9305

MECHANICAL DAMAGE TEST FOR SOYBEAN

Level of seed in sub hopper	Rate setting	Mechanical damage in Percent in different trials						
		I	II	III	IV	V	VI	VII
1	2	3	4	5	6	7	7	9
Full	Max.	0.32	0.25	0.24	0.4	0.24	0.32	0.21
	Optimum	0.34	0.34	0.45	0.23	0.23	0.12	0.23
	Min	0.23	0.35	0.32	0.21	0.21	0.22	0.43
¾ th	Max.	0.44	0.23	0.23	0.24	0.42	0.43	0.33
	Optimum	0.21	0.12	0.23	0.21	0.12	0.21	0.36
	Min	0.41	0.28	0.37	0.35	0.21	0.34	0.42
1/2	Max.	0.21	0.23	0.34	0.46	0.21	0.34	0.34
	Optimum	0	0.21	0.23	0.34	0.21	0.21	0.21
	Min	0.21	0.43	0.32	0.44	0.24	0.45	0.32
1/4 th	Max.	0.23	0.34	0.34	0.32	0.32	0.36	0.38
	Optimum	0.23	0.34	0.45	0.12	0.16	0.31	0.37
	Min	0.34	0.11	0.18	0.34	0.46	0.26	0.31

ANNEXURE-XIV

Date: 16/02/2018 Variety of seed: PKV-AKM-4

MECHANICAL DAMAGE TEST FOR BENGAL GREEN GRAM

Level of seed in sub hopper	Rate setting	Mechanical damage in Percent in different trials						
		I	II	III	IV	V	VI	VII
1	2	3	4	5	6	7	7	9
Full	Max.	0.21	0.32	0.22	0.26	0.23	0.29	0.34
	Optimum	0.23	0.34	0.45	0.23	0.26	0.32	0.22
	Min	0.22	0.25	0.34	0.44	0.4	0.37	0.37
¾ th	Max.	0.23	0.23	0.34	0.32	0.23	0.23	0.23
	Optimum	0.23	0.34	0.42	0.4	0.34	0.12	0.21
	Min	0.22	0.34	0.33	0.43	0.34	0.12	0.31
1/2	Max.	0.1	0.22	0.22	0.34	0.43	0.25	0.34
	Optimum	0.27	0.32	0.23	0.34	0.32	0.12	0.23
	Min	0.12	0.23	0.32	0.23	0.34	0.43	0.21
1/4 th	Max.	0.34	0.36	0.32	0.21	0.22	0.26	0.23
	Optimum	0.23	0.34	0.45	0.32	0.21	0.22	0.23
	Min	0.23	0.34	0.34	0.21	0.12	0.17	0.34

ANNEXURE-XV
SEEDING UNIFORMITY TEST

Date: 17/02/2018 Crop & Variety of seed: Soybean & JS-9305

Rate setting	Parameter	Test No.	No. of Furrow openers						
			No.1	No.2	No.3	No.4	No.5	No.6	No.7
1	2	3	4	5	6	7	8	9	10
	No. of seeds fallen per meter sand bed	I	145	135	139	135	141	143	142
		II	139	143	134	150	138	139	149
		III	150	144	139	142	143	137	141
		Avg.	144.67	140.67	137.33	142.33	140.67	139.67	144.00
	Variation from mean, %	I	-0.23	4.03	-1.21	5.15	-0.24	-2.39	1.39
		II	3.92	-1.66	2.43	-5.39	1.90	0.48	-3.47
		III	-3.69	-2.37	-1.21	0.23	-1.66	1.91	2.08
	Average distance between two seeds (cm)	I	53	56	57.33	57.33	57	56.66	57.66
		II	2.2	1.95	1.56	2.1	2.32	1.58	2.45
		III	2.3	2.54	1.97	2.43	1.89	2.34	2.34
		Avg.	2.58	2.67	1.34	2.54	2.87	1.7	2.56

ANNEXURE-XVI

FIELD PERFORMANCE RESULTS

Place: Farmer and University field
Type of Soil: Black soil
Gear selected: Low 3rd Previous
Feed rate position : Optimum

Name & variety of crop: Soybean & JS-9305
Name & type of fertilizer: DAP
Treatment: Rotavator operation

S. No.	Parameters	TEST TRIALS				
		I	II	III	IV	V
1	Date of Test	27/6/2018	27/06/2018	2/07/2018	3/07/2018	4/07/2018
2	Furrow length (m)	169	158	153	161	124
3	Net duration of test (h)	2.23	3.45	2.95	3.15	3.21
4	Soil moisture (%)	14.34	13.86	14.71	12.88	14.62
5	Bulk Density (g/cc)	1.33	1.32	1.33	1.35	1.34
6	Engine Speed (rpm)					
	-No load	1750	1755	1753	1755	1750
	-On load	1672	1669	1670	1677	1671
7	Av. Speed of travel (km/h)	3.31	3.00	3.15	3.49	3.21
8	Av. wheel slippage (%)	7.690	8.51	7.95	8.61	7.37
9	Av. Row spacing (cm)	38	38	38	38	38
10	Av. Depth (cm)					
	Seed	5.66	5.82	6.12	6.34	6.38
	Fertilizer	4.72	4.52	4.90	5.00	5.08
11	Av. Width of sowing (cm)	266	266	266	266	266
12	Area covered (ha/h)	0.598	0.550	0.566	0.623	0.594
13	Time required for one ha (h)	1.67	1.82	1.77	1.61	1.68
14	Seed rate (kg/ha)	80.70	82.20	81.40	81.70	80.90
15	Fertilizer rate (kg/ha)	112.50	114.30	111.80	115.10	113.70
16	Field efficiency (%)	67.98	68.89	67.56	67.10	69.51
17	Avg. draft, kgf	499	525	521	527	515
18	Power requirement, kW	4.56	4.35	4.53	5.08	4.57
19	Fuel consumption					
	l/h	3.64	3.66	3.57	3.61	3.64
	l/ha	6.08	6.66	6.07	5.80	6.13

ANNEXURE-XVII
FIELD PERFORMANCE RESULTS

Place: University Farm and farmer field
Type of Soil: Black soil
Gear selected: Low 3rd Previous
Feed rate position: Optimum

Name & variety of crop: Green gram & Kopargaon
Name & type of fertilizer: DAP
Treatment: Rotavaotor operation

S. No.	Parameters	TEST TRIALS				
		I	II	III	IV	V
1	Date of Test	29/6/2018	29/6/2018	3/07/2018	5/07/2018	5/07/2018
2	Furrow length (m)	105	160	154	139	117
3	Net duration of test (h)	2.30	3.18	2.89	3.60	1.98
4	Soil moisture (%)	14.16	13.13	14.87	12.52	13.78
5	Bulk Density (g/cc)	1.32	1.30	1.37	1.35	1.35
6	Engine Speed (rpm)					
	-No load	1753	1750	1755	1760	1755
	-On load	1679	1670	1674	1674	1679
7	Av. Speed of travel (km/h)	3.41	3.21	3.36	3.36	3.41
8	Av. wheel slippage (%)	9.84	6.73	8.10	8.10	6.41
9	Av. Row spacing (cm)	38	38	38	38	38
10	Av. Depth (cm)					
	Seed	6.34	6.24	6.32	6.32	6.12
	Fertilizer	4.98	5.00	5.12	5.12	4.94
11	Av. Width of sowing (cm)	266	266	266	266	266
12	Area covered (ha/h)	0.565	0.599	0.560	0.602	0.561
13	Time required for one ha (h)	1.77	1.67	1.78	1.66	1.78
14	Seed rate (kg/ha)	19.60	20.10	19.20	18.80	18.50
15	Fertilizer rate (kg/ha)	114.30	112.40	114.20	114.40	111.90
16	Field efficiency (%)	62.35	70.10	62.74	67.43	61.85
17	Avg. draft, kgf	520	530	525	535	532
18	Power requirement, kW	4.90	4.71	4.87	4.96	5.01
19	Fuel consumption					
	-l/h	3.61	3.60	3.65	3.63	3.62
	-l/ha	6.38	6.01	6.51	6.03	6.45

ANNEXTURE-XVI

BRIEF SPECIFICATIONS OF THE TRACTOR USED DURING FIELD TEST

1	**Make**	MAHINDRA AND MAHINDRA
2	**Model**	B-575 DI NB
3	**Engine**	
	Maximum hp	45
	Rated rpm	2300
	No. of cylinder	4
	Cubic capacity/Displacement, cc	2523
	Bore/stroke, mm	88.9/101.6
	Compression ratio	1
	Drawbar,hp	35
	Type	Water cooled, Four stroke, Direct injection, Diesel engine
4	**Air Cleaner**	One, Oil bath type
5	**Fuel filter**	Two, Primary felt and secondary paper element
6	**Gear box/Transmission**	
	Types of gear box	Combination of sliding and constant mesh
	No. of forward speed	8
	No. of reversed speed	2
7	**Clutch**	
	Type of clutch	Dry friction plate
	Size of clutch	280
	Single/dual	Single plate
8	**Hydraulics**	
	Maximum lift capacity in kgf at hitch point	1060 kgf
	Linkage category	CAT-I and CAT II
	Lift automatic depth and draft control	Yes
9	**Brakes**	Mechanical dry disc
10	**PTO**	
	PTO power hp	40
	SFC at max. Power (g/ptohp/hr)	180
	rpm	540
	No of splines	6
11	**Turning radius**	
	Minimum turning radius meters or mm (Without brake applied)	3
12	**Steering**	Worm, recirculating ball and nut type
13	**Fuel tank**	
	Capacity, lit	45

	Oil pan, lit	6
14	**Battery**	Lead acid
	Rating	12V, 88Ah for 20hours
15	Tyre	
	Front tyre size with ply rating	6x16 8PR
	Rear tyre size with ply rating	13.6x18 12PR
16	**Dimensions**	
	Overall length, mm	3260
	Overall width, mm	1770
	Overall height, mm	2020
	Ground clearance, mm	350
	Wheel base, mm	1910
	Track width front, mm	1240-1440
	Track width rear, mm	1270-1870
17	**Weight**	
	Tractor weight (Unballasted) in kg	1870
	Weight at front in kg	725
	Weight at rear in kg	1145

ANNEXURE-XVIII

The accuracy of measuring instruments shall have maximum allowable error as follows

Sr. No.	Particular	Error
1	Rotational speed, rev/min	±0.5 percent
2	Time, s	±0.2
3	Length, m or mm	±0.5 percent
4	Force, N	± 1 percent
5	Mass, kg	±0.5 percent
6	Atmospheric pressure, kPa	±0.2
7	Temperature of fuel, ℃	±2
8	Atmospheric temperature, ℃	±0.5
9	Soil moisture	±0.5 percent