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व्यावसायिक परीक्षण रिपोर्ट
COMMERCIAL TEST REPORT

संख्या / No. : Comb – 104/1537
माह / Month: September, 2013



**SELF PROPELLED COMBINE HARVESTER
'KARTAR-4000'**



सत्यमेव जयते

भारत सरकार
कृषि मंत्रालय
(कृषि एवं सहकारिता विभाग)

**GOVERNMENT OF INDIA
MINISTRY OF AGRICULTURE
(DEPARTMENT OF AGRICULTURE & COOPERATION)**

उत्तरी क्षेत्र कृषि मशीनरी प्रशिक्षण एवं परीक्षण संस्थान
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Sl. No.	Mass of peg tooth before test (g)	Mass of peg tooth after 50 hours of test (g)	Wear by weight (%)
a) Peg teeth of threshing cylinder			
1.	216.6	215.6	0.46
2.	207.8	207.1	0.34
3	223.0	221.0	0.90
4	211.9	211.6	0.14
5	217.0	216.0	0.46
6	215.6	215.3	0.14
7	223.2	222.2	0.45
b) Peg teeth of Concave			
1	206.7	205.8	0.44
2	207.5	206.8	0.34
3	224.6	223.8	0.36
4	214.4	213.7	0.33
5	211.6	210.9	0.33
6	220.1	219.9	0.09

17. SUMMARY OF OBSERVATIONS, COMMENTS AND RECOMMENDATIONS

17.1 Engine Performance Test

Engine Brake power, kW (Ps)	Crankshaft torque, Nm(kgf-m)	Engine speed (rpm)	Hourly fuel consumption kg/h (l/h)	Specific fuel consumption kg/kwh (kg/hph)	Specific energy, kWh/l (hph/l)
i) Maximum power - 2 hours test					
92.1(125.2)	409.2(41.8)	2250	24.468 (29.611)	0.266 (0.195)	3.110(4.228)
79.8 (108.5)	579.8 (59.2)	1375	18.574 (22.365)	0.233 (0.171)	3.566 (4.848) **
ii) Power at rated engine speed (2200 rpm)					
94.3(128.2)	428.6(43.7)	2200	24.507 (29.634)	0.260 (0.191)	3.182(4.327)
87.0(118.3)	395.3(40.3)	2200	23.858 (29.060)	0.274 (0.202)	2.994(4.070)*
iii) Maximum torque					
79.9(108.6)	550.8(56.2)	1450	18.878 (22.773)	0.236 (0.174)	3.509(4.770)
67.7(92.0)	520.7(53.1)	1300	17.207 (20.959)	0.254 (0.187)	3.230(4.392)*
72.1 (98.0)	601.0 (61.3)	1200	17.555 (21.126)	0.243 (0.179)	3.413 (4.640) **

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iv) Five hour rating test*					
a) Engine run at 90% of maximum power load					
81.4(110.7)	356.6(36.4)	2283	22.441(27.3 30)	0.276 (0.203)	2.980(4.052)
b) Engine run at maximum power load					
89.7(122.0)	407.7(41.6)	2200	24.133 (29.395)	0.269(0.198)	3.052(4.149)

* Under high ambient condition.

** At part throttle speed specified for field work (1600 rpm)

Remarks

- i) The maximum power output of the engine was observed as 92.1 kW (125.2 Ps) & 79.8 kW (108.5 Ps) at 2250 rpm and 1375 rpm of engine at full throttle and setting recommend for field operation respectively.
- ii) The specific fuel consumption corresponding to maximum power at full throttle and setting recommended for field operation was measured as 0.266 and 0.233 Kg/kwh (0.195 and 0.171 (0.174 kg/hph).
- iii) The back-up torque of the engine was measured as 30.8% in natural ambient at full throttle which is normal.
- iv) The maximum smoke density was recorded as 4.45 (Bosch No.) which is within permissible limit
- v) The maximum temperature of engine oil, coolant (water) and exhaust gas was observed as 108.4, 99.0 and 499.2° C respectively.
- vi) The lubricating oil & coolant consumption during five hours rating test were measured as 0.392 g/kWh (0.288 g/hph) and 0.32% of total coolant capacity respectively.

17.2 Turning ability

The radius of turning circle at LHS and RHS was observed satisfactory. Combine is not provided with independent brake pedals for right and left brake.

17.3 Visibility

The visibility around the cutter bar from operator's seat in normal sitting position is satisfactory.

17.4 Braking Performance

- i) The brake pedal force and stopping distance corresponding to 2.5 m/sec² are 7.59 m and 310.5N respectively and the performance is in line with the IS 12207-1987 & CMVR requirements.
- ii) The performance of parking brake was found satisfactory.

17.5 Mechanical Vibration

The amplitude of mechanical vibration of components marked as (*) in para 12 of this report are on higher side. This calls for providing suitable remedial measures to dampen the vibration in order to improve the operational comfort and service life of various components & sub assemblies.

17.6 Noise measurement

The noise level at bystander and at operator's ear level is found 92.5 and 99.7 dB(A) respectively which is more than specified noise level 88 dB(A) and 98 dB(A) in IS:12180-2000.



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17.7 Field Test

The results of the field test are summarized below:

S. No	Parameters	Range of parameters			Average of parameters		
		Wheat Harvesting	Paddy Harvesting	Gram Harvesting	Wheat Harvesting	Paddy Harvesting	Gram Harvesting
1.	Speed of operation (kmph)	1.84 to 4.09	3.16 to 3.39	2.84 to 3.38	3.54	3.25	3.14
2.	Area covered (ha/h)	0.535 to 1.435	0.710 to 1.144	0.635 to 0.874	1.112	0.925	0.726
3.	Fuel consumption: - (l/h)	6.793 to 12.705	6.140 to 11.333	6.800 to 8.571	10.009	8.820	7.212
	- (l/ha)	6.550 to 13.961	8.016 to 12.150	9.290 to 10.709	9.807	9.634	9.961
4.	Crop throughput (tonne/h)	6.6 to 15.6	11.2 to 15.5	5.4 to 13.5	12.6	12.7	7.9
5.	Grain breakage in main grain outlet(%)	0.820 to 2.365	0.206 to 0.611	1.500 to 2.192	1.737	0.382	1.951
6.	Header losses(%)	0.702 to 2.032	0.160 to 0.839	0.939 to 1.999	1.357	0.528	1.419
7.	Total non-collectable losses(%)	0.730 to 2.046	0.187 to 1.396	0.974 to 2.102	1.390	0.769	1.475
8.	Total collectable losses(%)	0.010 to 1.018	0.034 to 1.185	1.010 to 1.456	0.316	0.542	1.243
9.	Total processing losses(%)	1.839 to 2.403	0.546 to 1.666	2.835 to 3.600	2.100	1.164	3.251
10.	Threshing efficiency(%)	98.50 to 98.95	98.71 to 98.97	97.66 to 98.89	98.80	98.85	98.42
11.	Cleaning efficiency(%)	95.47 to 97.20	95.03 to 97.30	95.87 to 96.57	96.45	96.19	96.17

S. No	Parameters	Range of parameters			Average of parameters		
		Soyabean	Maize	Gwar	Soyabean	Maize	Gwar
1.	Speed of operation (kmph)	3.97 to 6.63	1.64 to 1.78	1.86 to 2.13	5.32	1.69	1.93
2.	Area covered (ha/h)	1.180 to 1.420	0.272 to 0.377	0.490 to 0.597	1.307	0.327	0.527
3.	Fuel consumption: - (l/h)	7.063 to 8.155	8.791 to 9.600	7.518 to 9.496	7.559	9.085	8.593
	- (l/ha)	4.995 to 6.911	25.464 to 33.401	14.973 to 17.917	5.841	28.047	16.299
4.	Crop throughput (tonne/h)	6.4 to 17.0	4.0 to 5.9	7.0 to 10.3	11.7	4.5	8.9
5.	Grain breakage in main grain outlet(%)	1.355 to 1.981	1.146 to 1.665	NIL	1.546	1.297	NIL
6.	Header losses(%)	1.032 to 1.888	0.401 to 1.179	1.087 to 1.516	1.576	0.829	1.278
7.	Total non-collectable losses(%)	1.437 to 1.946	0.438 to 2.424	1.572 to 2.330	1.736	1.297	1.978

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8.	Total collectable losses(%)	0.000 to 1.546	0.000 to 0.539	0.104 to 0.190	0.479	0.212	0.124
9.	Total processing losses(%)	1.476 to 3.546	1.227 to 3.429	0.667 to 1.433	2.188	1.978	0.907
10.	Threshing efficiency(%)	98.00 to 98.94	98.44 to 99.69	98.50 to 99.22	98.47	98.82	98.78
11.	Cleaning efficiency(%)	95.53 to 96.67	95.47 to 96.50	96.13 to 96.74	96.06	86.17	96.39

17.7.1 Wheat Harvesting

- i) The grain breakage in PBW 550 variety ranged from 0.820 to 2.365% (Average 1.737%) which is within the specified limit of 2.5% in IS: 15806-2008.
- ii) The total non collectable losses ranged from 0.730 to 2.046% (Average 1.390%) which is within specified limit of 2.5% in IS: 15806-2008.
- iii) The total processing losses ranged from 1.839 to 2.403% (Avg.2.100 %) which is within specified limit of 2.5% in IS: 8122(Part-1)1994.
- iv) The threshing efficiency ranged from 98.50 to 98.95% (Average 98.80%) which is above the specified limit of 98% in IS:15806-2008.
- v) The cleaning efficiency ranged from 95.47 to 97.20 % (Average 96.45%). Average value is above the specified limit of 96% in IS:15806-2008.

17.7.2 Paddy Harvesting

- i) The grain breakage ranged from 0.206 to 0.611% (Average 0.382%) which is within specified limit of 2.5% in IS:15806-2008.
- ii) The total non-collectable losses ranged from 0.187 to 1.396% (Average 0.769%) which is within specified limit of 2.5% in IS:15806-2008.
- iii) The total processing losses ranged from 0.546 to 1.666% (Average 1.64%) which is within specified limit of 2.5% in IS:8122(Part-1)1994.
- iv) The threshing efficiency ranged from 98.71 to 98.97% (Average 98.85%) which is above the specified limit of 98% in IS:15806-2008.
- v) The cleaning efficiency ranged from 95.03 to 97.30 % (Average 96.19%). Average value is above the specified limit of 96% in IS:15806-2008.

17.7.3 Gram Harvesting

- i) The grain breakage ranged from 1.500 to 2.192% (Average 1.951%)
- ii) The total non collectable losses ranged from 0.974 to 2.102% (Average 1.475%) which is within sprified limit of 2.5% in IS:15806:2008
- iii) The total processing losses ranged from 2.835 to 3.600% (Average 3.251%) which is higher than the sprified limit of 2.5% in IS:8122 (Part-1):1994
- iv) The threshing efficiency ranged from 97.66 to 98.89% (Average 98.42%)
- v) The cleaning efficiency ranged from 95.87 to 96.57% (Average 96.17%)



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17.7.4 Soyabean Harvesting

- i) The grain breakage ranged from 1.355 to 1.981% (Average 1.546%)
- ii) The total non collectable losses ranged from 1.437 to 1.946% (Average 1.736%) which is within sprified limit of 4.0% in IS:15806:2008
- iii) The total processing losses ranged from 1.476 to 3.546% (Average 2.188%) which is within the specified limit of 4.0% in IS 8122 (Part-1): 1994
- iv) The threshing efficiency ranged from 98.00 to 98.94% (Average 98.47%)
- v) The cleaning efficiency ranged from 95.53 to 96.67% (Average 96.06%)

17.7.5 Maize Harvesting

- i) The grain breakage ranged from 1.146 to 1.665% (Average 1.297%)
- ii) The total non collectable losses ranged from 0.438 to 2.424% (Average 1.297%)
- iii) The total processing losses ranged from 1.227 to 3.429% (Average 1.978%)
- iv) The threshing efficiency ranged from 98.44 to 99.09% (Average 98.82%)
- v) The cleaning efficiency ranged from 95.47 to 96.50% (Average 96.17%)

17.7.6 Gwar Harvesting

- i) The grain breakage is in NIL in gwar crop
- ii) The total non collectable losses ranged from 1.572 to 2.330% (Average 1.978%)
- iii) The total processing losses ranged from 0.667 to 1.433% (Average 0.907%)
- iv) The threshing efficiency ranged from 98.50 to 99.22% (Average 98.78%)
- v) The cleaning efficiency ranged from 96.13 to 96.74% (Average 96.39%)

Losses are with in the specified limit and efficiencies are above the specified limit of Indian Standard on wheat, paddy, gram and soyabean crops.

17.7.3 Harvesting of any other crops

The performance of combine to harvest wheat paddy, gram, soyabean, maize and gram crops was evaluated as the same were recommended by the applicant in addition to wheat and paddy crops.

17.7.4 Ease of Operation and Safety Provision

- i) The controls provided around the operator are within easy reach and labelled but not with symbols as per Indian standard. Therefore, it is recommended that the symbols as per the requirement of IS-6283-1998 may be provided at production level.
- ii) The design of stone trap need to be modified for easy cleaning without removing header unit.
- iii) Spark arresting device is not provided in the engine exhaust system which is considered essential.
- iv) Slip clutch / safety device in lifting platform and grain & tailing elevator are considered essential from safety point of view which needs to be provided at production level.
- v) The mechanical arrangement for adjusting the reel speed though provided, needs to be modified such that the same could be controlled from operators position.
- vi) The grain tank needs to be provided with suitable grain fill indicator device.

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17.7.5 Assessment of Wear

- i) The wear of engine components i.e. cylinder liners, piston, piston rings, valves, valve guides, springs, big-end bearings and main bearings were observed within the permissible limit.
- ii) The transmission gears and components were found in normal working condition.
- iii) The timing gears, clutch lining, release bearing were found in normal working condition.
- iv) The condition of the components of brake, hydraulic system and steering system was observed to be normal.
- v) The condition of the bearing, chains, sprockets and belts was observed to be normal.
- vi) The components of starter motor and alternator were found in normal working condition.
- vii) The rate of wear of rasp bar and peg teeth of threshing cylinder & concave were observed as normal.

17.8 Chemical composition

- i) Chemical composition of knife blade does not conform with limits specified in IS: 6025-2004. Components conforming to Indian standard should be used at production level.

17.9 Maintenance/Service problems:

No noticeable maintenance/service problem was observed during the course of test at this Institute.

17.10 Labelling of Combine Harvester:

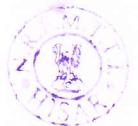
The labelling plate as per IS: 10273-1999 is provided on the combine harvester.

17.11 Literature supplied with the Machine:

The following literatures have been supplied by the manufacturer

- i) Parts catalogue
- ii) Service manual
- iii) Repair and maintenance
- iv) Manual of engine

However it needs to be modify as 8132-1995 in Hindi & other regional languages for the guidance of users.



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18. SELECTED PERFORMANCE AND OTHER CHARACTERISTICS AS PER IS: 15806-2008

S. No.	Characteristics	Requirement	Declared	Observed	Remark
i)	Prime mover performance				
a)	Max. Power (absolute) Average max. power observed during 2 hrs. max. power test in natural ambient condition kW(Ps)	It should not be less than 5% of the declared value.	96.0 (130.5)	92.1(125.2)	Conforms
b)	Max. power observed during test after adjusting the no load engine speed as per recommendation of the manufacturer for field work, kW(Ps)	Max. power observed must not be less than 5% of declared value.	75 (102)	79.8(108.5)	Conforms
c)	Power at rated engine speed, kW(Ps)	The observed value must not be less than 5% of the declared value by the applicant.	96.0 (130.5)	94.3(128.2)	Conforms
d)	Specific fuel consumption g/kWh.	The average observed value under 2 hr. max. power test must be within $\pm 5\%$ of the declared value by manufacturer.	235 $\pm 5\%$	266	Does not conform
e)	Max. smoke density (bosch no.) at 80% load between the speed at max. power & 55% of speed at max. or 1000 rpm which ever is higher, should be observed as per CMVR rule	For tractor :- 5.2 bosch no. or 75 hartridge For engine :- Free deceleration or natural aspirated or turbo charges - 65 hartridge	--	4.45	Conforms
f)	Max. crank shaft torque, (N-m) observed during the test after no load engine speed is adjusted as per manufacture's recommendation for field work	It must not be less than 8% of declared value by manufacturer.	475 N-m	601.0	Conforms
g)	Back up torque, %	7% min.	--	30.8	Conforms
h)	Max. operating temp ^o C	To be declared by the manufacturer.	120	108.4	Conforms
i)	Engine Oil ii) Coolant		95	99.0	Does not conform
i)	Lubrication oil consumption, g/kWh	1% of SFC at 5hr. max. power test during high ambient condition with tolerance limit of +10%.	2.69 $\pm 10\%$	0.392	Conforms

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ii)	Brake performance				
a)	Max. stopping distance at a force equal to or less than 600 N on break pedal, m	$10 \text{ m or } S \leq 0.15V + V^2/130$ V= speed corresponding to 80% of design max. speed, kmph	--	7.59m at 310.5N	Conforms
b)	Max. force exerted on brake pedal to achieve a deceleration of 2.5 m/sec ² .	≤ 600N.	--	310.5N	Conforms
c)	Whether parking brake is effective at a force of 600 N at foot pedals or 400 N at Hand and lever	Yes/ No	--	Yes	Conforms
iii)	Mechanical vibration (Amplitude of Vibration) at				
a)	Operator's platform	120 μm max.	--	130 μm	Does not conform
b)	Steering wheel	150 μm max.	--	190 μm	Does not conform
c)	Seat (with driver seated)	120 μm max.	--	140 μm	Does not conform
iv)	Air cleaner oil pull over				
a)	Max. Percentage of oil pullover	0.25% max.	--	Not applicable as dry type air cleaner is provided	--
v)	Noise measurement				
a)	Max. ambient noise emitted by combine dB (A)	88 dB (A) as per CMVR	--	92.5 dB(A)	Does not conform
b)	Max. noise at operator's ear level dB (A)	98 dB (A) as per CMVR,	--	99.7dB(A)	Does not conform
vi)	Discard limit of				
a)	Cylinder bore diameter, mm	Should not exceed the values specified by the manufacture	107.534	107.29(max)	Conforms
b)	Piston diameter, mm	-do-	106.40	106.52(min)	Conforms
c)	Ring end gap, mm	--do--	2.0	0.55(max)	Conforms
d)	Ring groove clearance, mm	--do--	0.20	0.10 (max)	Conforms
e)	Diametrical and axial clearance of big end bearing, mm	-do-	Diametrical 0.18 Axial 0.25	Diametrical 0.10(max) Axial - 0.20(max)	Conforms
f)	Diametrical and axial clearance of main bearings, mm	--do--	Diametrical 0.178 Axial 0.356	Diametrical 0.10(max) Axial 0.15	Conforms Conforms
g)	Thickness of brake lining mm	--do--	Up to rivet head	6.1mm	Conforms
h)	Thickness of clutch plate, mm	--do--	Up to rivet head	2.90 mm above rivet head	Conforms



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vii) Field performance						
a)	Suitability for crops	Wheat & paddy essential	Wheat & paddy	Suitable for Wheat & paddy, gram, soyabean, maize & gwar	Conforms	
b)	Grain breakage in grain tank	$\leq 2.5\%$	-	Wheat- 0.820 to 2.365% (Avg.=1.737%) Paddy- 0.206 to 0.611% (Avg.=0.382%) Gram 1.50 to 2.192 (Avg. 1.951%) Soyabean 1.355 to 1.981 (Avg.1.546%) Maize 1.146 to 1.665 (Avg.1.297) Gwar NIL	Conforms for both wheat and paddy Not specified for other crops.	
c)	Non collectable losses	$\leq 2.5\%$ for wheat, paddy & gram and $\leq 4.0\%$ for soyabean,	-	Wheat- 0.730 to 2.046% (Avg.=1.390%) Paddy- 0.187 to 1.396% (Avg.=0.769%) Gram 0.974 to 2.102% (1.475%) Soyabean 1.473 to 1.946% (Avg.1.736%) maize 0.438 to 2.424% (Avg.1.297%) Gwar 1.572 to 2.33% (Avg.1.978%)	Conforms for wheat, paddy, gram and soyabean Not specified for gwar & maize	
d)	Threshing efficiency	$\geq 98\%$ wheat & paddy	-	Wheat- 98.50 to 98.95% (Avg.=98.80%) Paddy- 98.71 to 98.97% (Avg.=98.85%) Gram 97.66 to 98.89% (Avg.98.42%) Soyabean 98.0 to 98.94% (Avg.98.47%)	Conforms for both wheat and paddy Limit not specified for other crops	

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				Maize 98.44 to 99.09% (Avg.98.82%) Gwar 98.50 to 99.22% (Avg.98.78%)	
e)	Cleaning efficiency	≥ 96 % wheat & paddy	-	Wheat 95.47 to 97.20% (Avg.=96.45%) Paddy- 95.03 to 97.30% (Avg.=96.19%) Gram 95.87 to 96.57% (Avg.96.17%) Soyabean 95.33 to 96.67% (Avg.96.06%) Maize 95.47 to 96.50% (Avg.96.17%) Gwar 96.13 to 96.74% (Avg.96.39%)	Conforms for both wheat and paddy Limits not specified for other crops
viii)	Safety requirement				
a)	Guards against all moving parts/drives and hot parts	Essential		Provided	Conforms
b)	Lighting arrangement 1. Head light 2. Parking light 3. Indication 4. Reverse gear 5. Brake 6. Number plate	Essential as per CMVR	--	Provided	Conforms
c)	Grain tank cover	Essential	--	Not provided	Does not Conform
d)	Spark arrester in engine's exhaust	Essential	--	Not provided	-- (However] the turbo charged engine eliminates the requirement of the separate spark arrester)



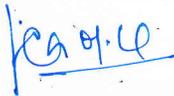
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	e)	Stone trap before concave	Essential	--	Provided	Conforms
	f)	Rear view mirror	Essential	--	Provided	Conforms
	g)	Slip clutch at following drives - 1. Cutting platform auger drive 2. under shot conveyor drive 3. Grain & tailing elevator drive	Essential	--	Not Provided Provided Not Provided	Does not Conform Conforms Does not Conform
	h)	Anti slip surfaces at operator platform & ladder & proper gripping for the control levers	Essential	--	Provided	Conforms
	i)	Working clearance around the controls	Essential 70 mm, min.	--	Provided	Conforms
	j)	Labelling of control gauge	Essential	--	Provided	Conforms
ix)	Material of construction :					
	a)	Guard should conform to IS: 6024 -1983	The guard (except ledger plate) shall be manufactured from malleable iron casting (IS: 2108-1977), steel casting (IS: 1030-1974) or steel forging (IS: 2004-1978)	-	C= 0.62 Si= 0.34 Mn= 0.61 P= 0.035 S= 0.033	Unascertainable as the relevant code does not specify the limit of content.
	b)	Knife blade As per IS :6025 -1982	It must have Chemical composition as C= 0.70-0.95 % Mn =0.30-0.50 %	-	0.62% 0.95%	Does not conform
	c)	Knife back Must meet the requirement of IS:10378-1982	The knife back shall be manufactured from Carbon Steel having minimum carbon content of 0.35 %	-	Carbon 0.21%	Does not conform
x)	Labelling of combine harvester					
		It should conform to IS: 10273-1987	Essential, It should mention make & model ,Engine No. Chassis No., Year of manufacture, Power & SFC of engine	--	Provided	Conforms

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xi)	Break down (critical, major & minor)			
		Essential as per IS: 15806-2008 Annexure A ₁ , A ₂ , A ₃	--	None

TESTING AUTHORITY

(R.M. TIWARI) AGRICULTURAL ENGINEER	
(P. K. CHOPRA) SENIOR AGRICULTURAL ENGINEER	
HIMAT SINGH -DIRECTOR-	

