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Design and Wear Analysis of Rotary Tiller Blades: A Review

***Nikhil Metange*[1]*, K. T. Patil*[2]**
Research Scholar[1]
Department of Mechanical Engineering
ShreeyashEngg. College, Dr.BAMU Technical University, Aurangabad, Maharashtra
Corresponding Authors' email id: *metangenikhil@gmail.com*

Abstract

Rotary tiller blades are used to prepare or to make a soil bed, the rotary tiller blade works in any type of soil. But, most wear problems occur in the dry soil condition. To find out the solution of problem of wear out the project mostly concentrated about the material and its analysis under the loading condition. In such study, we focus on improving service life of rotary blade and study about its working hours etc. The aim is carried out by means of design and analysis of a blade. To design the efficient blade, we are going to test the blade under different material analysis and test the blade under different load condition. To get the efficient final blade structure we are going to review the different literatures and study different deigns of rotary tiller blades. The blade with the different load conditions will analyze and tested. We are also validating the results with the analytical solution and experimental module of the proved final module. We will test the experimental module under the different load conditions.

Keywords: *Rotary tiller, Wear in agricultural machinery, Abrasive wear, Hard facing, Wear resisting coatings*

I. INTRODUCTION

Introduction of the Project:

The agriculture equipment contains common problem of wear in much of the metallic equipment in the machines. The wear problem solutions are provided by the researchers and the maximum researcher worked on the material and its analysis. The agricultural equipment's are much of the load bearing capacity and it is made to handle a maximum load at the run or dynamic condition.

Among those soil cuttings agri-equipments now days, so, the the rotary tiller blade is maximum used by the farmers, which gets the maximum efficiency and output to the farmers. The rotary tiller blade is an equipment that used for harvesting in the soil and to avoid trash burning which can help the agro ecological systems. [1, 3] Where is the main reason that limits in the agricultural tools damage? These tools (soil cutting) have their own characteristics of wear which are different than other types. A single rotary tillage blades is sufficient for complete the several conventional tillage operations. Although the rotary tillage is an energy and time efficient pieces of equipment, Rapid wear of the tiller blades, normally made from the medium carbon steel. Mild steels, in-certain conditions may restrict in use. The heat treatment process is carried out to provide protections to the blades to increase the service life of the carbon steel blades and thus cost is reduced of the agricultural production equipment's. The rotary tiller has been used for paddling in paddy fields and cultivation in other agricultural fields. However, studies on the wear of the blades and its wear resistance of different surface treatments are scarce, but wear is important factor for predicting service life of blade. The surface of the tiller blade, which is normally heat treated during manufacturing. Thus, blade achieves high wear resistive properties. [1,2] When a rotavator blade is engaging some dry land agricultural areas so, abrasive wear takes place so that blade gets failed. Heavy agricultural equipment's operators and farmers always faced with the frequent labor system, equipment down time and reinstating cost of worn out earth engaging equipment's.

The tillage capacity of the worn out tools decreases and thus fuel Consumption of tractor increases. So, in the above figure by using CAD Software they complete the structural analysis .Solid model is prepared and results obtained in simulation from action of stress and its deformations. The rotary tiller blade has a maximum wear out and fatigue problems occur during the operation, the exact form to find its solution is starts from the soil condition study of the area where the rotary tiller blade is going to operate. The alternative way is to take the sample of few surveys of the soil types and select the maximum hard material require for that area to avoid the problem of wear out due to the maximum loading condition.

2. LITERTURE REVIEW

Wear behavior of hardening on rotary tiller blade, Amardeep singhkang, Gurmitsingh Cheema and Shivani Singla. [1] They work on rotary tiller blades, used to save time, human efforts to prepare soil beds. These tiller blades subjected to extreme surface wear and service life their aim is to improve service life of tiller blade under hard facing and chromium is used to provide more hardness by the gas tungsten welding. The average wear rate without chromium plating is more as compared to the 5 HCr, 7.5HCr. 9 HCr, 12 HCr. GTAW process is used to provide high resistance to wear and low cost. Satit Karoonboonyanan, Vilas M. Salokhe, Panadda Niranat lumpong. [2] In Wear resistance of thermally sprayed rotary tiller blades researchers focused on the increase of life of the blades to maintain the periodicity of blades. The hard coating of the blades minimizes the wear rate of blades by the thermal spray coating.

1. HVOF- High velocity oxygen fuel spray WC/CO
2. Plasma coating spray AL2O3-Tio2/NiAl on carbon steel blades.

Results of the above paper shows that the average wear rate of the uncoated blade is more than the coated blades (0.86 CM3/ha)but in the coated blade WC/CO is very little (0.02) than Al2O3 blade (0.9) respectively. So, WC/CO is high reliable more wear resistant and reduces labor cost. Amardeep Singh Kang, Gurmit Singh Cheema and Shivani Single, Dipak Jain [3] the rotavator is used to improve the soil conditions, under dynamic operating conditions the rotary tiller blades are under the loading effects of the soil and in that condition, wear problem occurs frequently. To avoid that problem, we are going to use the thermal spray coating to improve the wear resistance of the rotary tiller blades. To improve The blades reliability and straight they have did thermal spray coating. Three different detonation gun sprayed coating like-CoCr, Cr3C2NiCr and stellite 21 are compared in this study to get the better resultSo, from the result and conclusion of the project we know that, wear rate of the uncoated blade is more than the WcCoCr, Cr3C2NiCr and stellite 21..J E Ferhandez, R Vijande, R. Tucho, J. Rodrigulz and A Martin. [4] Hard alloys are used as materials for excavators teethe are used in mining industries. Several cast iron and alloys were studied from that they conclude that the coating gives the anti-wear properties in to the blades. Cast iron with the low carbon content doesn’t perform well. (Cr-Nb). Also, boron Cr-Nb-V (MR3) have low wear ration, the wear resistance clearly shown by the coating, quality and process.Yeilmaz Beyhan, [5] Here increase the wear behavior by covering the chisels ploughshare produce with low alloy steel with 3 different hard facing electrodes EH 600, EH 350and EH-14 Mn. These electrodes were chosen because they provide high resistance to wear and low cost and manage hardness upto 155-165 HB welding process – SMAW method was used. Base metal is carbon and filler metals are hard Facingby electrodes.

- High resistant wear.
- Cheaper rate in market

C H Ramulu, AK Dave, I Srinivas and B Laxman [6] The tractor connected with the rotavator blades are having less life under the heavy shock loads. So, the blades become wearing out very soon. The blades are faces the wear problems dynamic loading, blades are subjected to the fatigue and abrasive wear, so, ideal time and maintenance cost increases. So, they used suitable material of L type blades. Two rotavator blades are considered here blade 1 and bldae2; each blade has different compositions, mechanical and micro structure properties. Hence result is obtained the wear loss of blade 1 is higher than blade 2. These blades are selected and manufacturing locally. Blade 2 has low wear loss and higher hardness also has silicon phosphorous and chromium is more than blade 1 along such compositions.

PunamchandSapakale, GhanshyamTiwari and Ajay Sharma [7] Wear of soil engaging components takes place due to abrasive wear of these software material takes place. Due to improper material, and surface hardening treatments, the tool life reduces, high wear rates takes place. So, the surface hardening of the agricultural tools must be required surface modifications, heat treatment techniques and surface modifications techniques are used for wear improvement, life of the materials of soil working elements. AndrenaAngelastro, Sabina L. CampanelliGiuseppCasaleno, and Antonio D. Ludovico. [8] The surface coating techniques, laser cladding has been used for improving wear, corrosion, and fatigue properties of mechanical components. The main advantages of these process is to be capability to introduce hard particles like Sic, Tic and WC as reinforcement in the metallic matrix like Ni based alloy, Co based alloy and Fe based alloy to form ceramic metal composite coatings which have very high hardness and good wear resistant. Andin this paper Ni based alloy, WC Co Cr composite coatings is fabricated by using multilayer laser gladding technique. [MLC] on AISI 304 steel substrate, A mathematical model is used to calculate optimal values of laser beam translation speed. Laser cladding techniques increases the hardness of Wc Co Cr and Ni based alloy. M C Sharma and SCmodi. [9] Abrasive wear of the soil engaging tools occurs, from cost consideration tools may form the carbon steels. To enhance wear resistance and tool life of such carbon steel is studied the effect of shot-peening, coating and coating with post shot peening. Shot peening after coating has shown considerable improvement on abrasive wear resistant than steel blades due to the coating, hardening, etc. Percentage wear of shot peened self-fluxed alloy coated blades was found to be low compare to actual blade specimens. Commercially available low carbon steel SAE-1022 and spring steel En-42were selected to study with hardness 31.3HRC and 51.8 HRC .Uses of shot-peening after coating improves wear resistant characteristics of the surface. Sanjay Kumar, DP Mondal, A K Jha. [10] Hard facing of the surface modification techniques is use to rebuilt the surface of the work piece. Here used three hard facing electrodes having different chemical compositions and their abrasive response compared with mild steel. The results are obtained that the wear rate of hard facing alloys lowers than mild steel. Suga abrasion tester were used for abrasive wear tester , in such study these three hard facing alloys contain highest Cr for low wear rate. S. Selvi, S P Sankaran and R. Srivastavan, [11] In this present investigation hard facing of valve seat ring is done by manual metal arc welding [MMAW] process with 3 different electrodes. Main focus on the influence of carbon and chromium variations on wear, harden-ability and corrosion rate and effect on micro structure, etc. hard facing improves the service life of material, also provides excellent wear resistance, increasing hardness and better corrosion resistant, role of carbon and chromium is important M Salokhe, W Chuenpakaranant and T. Niyampa.[12] The performance of rotavator blade under coating and enamel coated tines was evaluated. Power required higher than uncoated blade but it gives soil inversion by 30 to 5o%. So, slightly higher power required and enamel coating reduces the weight loss of tines due to the reduce friction. These might be an added advantage of enamel coating. The soil inversion by enamel – coated tines was the soil inversion by enamel – coated tines was 30 – 51 % higher during second and third pass. Thus enamel – coated tines create more favorable soil condition than uncoated tines.VineetShibe and VikasChawla. [13] Wear is main reason of machinery components for failure in the form like abrasion. Wear resistant of material can b improved though surface modification technique, most worn parts don't fail form a single mode of wear but form a combination of modes, like abrasion and erosion. In such papers, it is an attempt to conduct experimental studies on different wear resistance hard facing alloys, which are employed on the surface of the material by different welding processes. Effort should be made for the right selection of surfacing materials and the process to achieve the full advantage of hard facing.

Amir Aadeghi and M. HeydarzadehSohi. [14] In this study microstructure and wear resistance of wear resistance of materials is studied by using the TIG surface melting as well as molybdenum and chromium surface alloy of the austempered ductile iron. Chromium and molybdenum surface alloying also reduce the wear rate of ADI about the 66 to 68% Respectively, Hardness increases 885 to 1065 HV. And wear rate reduces by ADI is 32 to 37 %. The Austempered ductile iron (ADI) widely used in industries like mining, agricultural and railroad etc.S. Kumar, D P Mondal, H K Khaira, A K Jha. [15] High stress abrasive wear behavior of mild steel, medium carbon steel and hard facing alloy has been studied to improve the wear properties after hard facing of steel, for high stress abrasive wear test media is used like silicon carbide particles. So, wear rate of the hard-facing alloys is lower than the uncoated mild steel and medium carbon alloy steel. Thus, the hard facing is a solution for change the material composition and heat treatment. Hardfacing was carried out by the Open Arc Welding process, Suga abrasion tester used for high abrasion test .R Das Gupta, B K Prasad, A K Jha, O P Modi, S das, and A H Yegneswaran. [16] Plane carbon steel was overlaid with hard facing alloys by manual arc welding. Various factors controlling the wear characteristics of the samples are observed to be their bulk hardness, subsurface work hardening and formation, stability of wear in reduce transfer layer and its subsequent removal through micro tracking by studying the micro structural results obtained from the wear surface and sub surface regions of the materials.

C. Manivelprabhu ,Dr.N.Sangeetha, T.Ramganesh.[17] The rotavator tiller used for soil bed preparation in agriculture land. The tiller blade directly engages in soil bed preparation , life of blade is 50 hour. so farmers are in tension for replacement cost or wear , when blades comes in contact with soil and blade get failed due to fatigue. For improving blade life design modification takes place in such study and structural analysis by using Catia R-20 and Hypermesh 12.0 software to simulate stress distribution in the existing and new blades. Structural analysis provide more accurate results so the time and cost for prototype is reduced.SK Mondal , Dr.B.Bhattacharya and Dr.S.Mukhurjee.[18] Tillage performs the operation in field so that we get desirable soil structure for a seedbed .A granular structure is desirable to allow rapid infiltration and good retention of rainfall.Now-a- days utilization of a rotary tillers has been increased in agriculture application due to high efficiency and simple structure .High stress develops on blade tip or blade critical edges. So, that blade optimization is necessary by using Computer Aided Design package for designing o the blade and Ansys programming was used for simulation and optimization of the blade. This research focuses on the design optimization of rotary tillers blade with focus different shapes . so result is obtained as the L-shapes blades face lower stress than other types with higher factor of safety ,hence working life of material increases successfully. H.fang , Q.Zhang et al.[19] Under the study of straw-soil-rotary blade interaction operated under controlled condition .one IT225 rotary blade was operated at 77rpm with 0.222 m/s forward speed and working depth was 100 mm .The unburied percent of 150 mm straw decreased from 98 % to 91 %. When rotavator kinematic parameters increased from 6.8 to 10.8 , Straw forward movement was larger than soil and straw movement.

M.A.Matin ,J.M.A.Desbiolles , J.M.Fielke [20] In this study , the use of rotating straight blades with a range of cutting edge geometries for cutting a 50 mm wide-strip-till furrow. The furrow formation was aided by using inside chamfered blades and a small bite length of 20 mm for strip-tillage and these compared with common double – side chamfered C-blades which uses commercially this blade design would be easier to manufacture locally at village level that’s the aim.

M.A.Matin ,J.M.Fielke, J.M.A.Desbiolles [21] Effect of three different geometries of blade considered here at four different rotary speeds on furrow seedbed parameters . During travelling of rotary tiller in sandy loam soil travel with forward speed 0.67 m/s. Straight blade reduced the soil carrying and throwing at 500 rpm all the blades gives the better performance , so that the study recommend's the use of straight blades which were operated at speeds 375-500 rpm which corresponds to bite length 20-37 rpm.M.A.Matin ,J.M.Fielke, J.M.A.Desbiolles [22] Optimization of the blade geometry and operational settings is the aim of the rotary tiller blade , during working for seedbed for the preparation of three different geometries at four rotary speeds on torque, power and energy characteristics .

The straight blade design required for least torque average power , peak power, specific energy and effective specific energy at 375-500 rpm .This straight blade saved upto 20-25 % power when compared with other blade at 500 rpm the straight blade indicates the high effectiveness for strip tillage operations.

G. U. Shinde , J.M. Potekar et al. [23] Optimization of the rotary tillage tools by using FEM , Simulation method was done by CAD-Software for the structural analysis , tiller blades geometrically prepared by using solid model and simulation is done with actual field performance by using boundry conditions ; power of tractor used 35-45 Hp. The resultant effect on tillage blade was obtained from stress distribution and deformation plots. New designs prefers here by changing dimensions , weight of new blade increases upto reliable strength so it gives better performance i.e. new blade.A.Jeevarathinam , C.Velmurugan [24] The blades of cast iron are defectful , so now for improving this here consider different materials compositions and dimensions for analysis to modifiesd new blade designs . Hence the new blade increases the working hours of the blades as well as wear resistance of the blades.

The design optimization and manufacturing errors can be minimized by its components design analysis and optimization.

G.M.Vegad ,Dr.R.Yadav , and R.G.Jakasania [25] In this study finite element analysis of Hatchet type blade of rotavators was carried out using Solid-Works software and static structural analysis of blade was carried out using ANSYS software. Also selection of material and the blade dimensions oh Hatchet type blade was selected as per Indian Standard IS: 6690-1981.Hence the result obtained i.e. max. deformation observed at 4.14 mm for Hatchet type blade at given boundry conditions.

Table: 1

Author	Basic Material	Coating Material	Hardness Of New Material	Coating Technique	Temperature For Tempering	Temperature For Oil-Quenching	Welding Process	Testing Machine	Electrodes Used	Tractor Power	Results
A.S.Kang et al. , 2004	High tensile steel	Used Cr with increase in percentage	62-65 HRC	Hardfacing	430-500 degree Celsius	780-810 degree Celsius	GTAW	Pin-on -Disk	_	60 Hp	When percentage of Cr increases wear rate decreases
S.Karoonbooyanan et al. , 2007	Carbon steel	1)Wc/Co 2)Al2O3	1)85-89 HRC 2)84-85 HRC	1) HVOF Spraying 2)Plasma Spraying 3) Thermal Spray Coating	–	–	Thermal Spray Coating	Rockwell Superefacial Hardness	–	14-PS Yanmar Ke-160 tractor	The blade Wc/Co is Superior 43 times than respective blades
A.S.Kang et al. , 2012	High tensile steel	1)Wc/Co/Cr 2)Cr3C2NiCr 3)Stellite-21	1)1300 HRC 2)1000 HRC 3)462HRC	1) Detonation gun spray technique(D-gun) 2)Thermal spraying	430-500 degree Celsius	780-810 degree Celsius	Thermal spray coating	Blades are tested by Volume losses after experiment	_	55 Hp	Wc/Co/Cr blades gives high wear resistance compare to other blades
J.E.Ferhandez et al. , 2001	Cast iron with low percentage of Carbon	1) Boron 2) Cr-Nb-v	1)65.6 HRC 2)64.7 HRC	Hardalloys coated on cast iron	–	–	Semi-automatic electric welding machine	Macrometdurometer in Rockwell C-scale and in Vickers scale	V, Cr, Ni etc.	Testes taken on time management	Alloys of Cr/Nb/V and Boron have low wear ratios with high hardness
YilmazBayhan , 2006	Carbon steel	1)EH-600 2)EH-350 3)EH-14Mn	1)50HRC 2)35HRC 3)3HRC	Hardfacing	–	–	Shilded metel-arc welding	Prototype wear Tester	Fillers metals 1)EH-600 2)EH-350	–	Electrodes Eh-600 and Eh-350 have low wear rate as well as

											cost.
CH.Ramulu et al. , 2016	1) C-steel 2) Mn- steel	Here takes two Rotavatorblades with different element composition & mechanical properties.	Blade 1- 44.66 HRA Blade 2 -45.33 HRA	Hardfacing	–	–	–	1)Rockwell hardness tester 2)Optical emission spectrometer 3) Electron microscope	–	47 Hp	The composition of Si, P and Cr increases wear resistance , life of blade
P.R.sapkale et al. , 2016	Lit. survey on carbon steel mild steel etc.	–	–	–	–	–	–	–	–	–	–
A.Angelastro et al. 2013	AISI 304 steel Stainless steel	1) Ni-based alloy 2) Wc/Co/Cr alloy	700-720HV	Laser cladding , Surface coating technique at 915 degree Celsius	—	–	Multy-layer laser cladding at 915 degree Celsiuus	Optical microscope used to analyse Macro and Micro-structure of sample	1)Ni-based alloy(Colmonoy 227-F) &Wc/Co/Cr 2) Argon used as shielding gas	–	Using Laser cladding process , increases the hardness of Wc/Co/Cr and Ni-based alloy
MC Sharma et al. ,1996	Carbon steel	SAE 1022 EN-42 (HT) 1)Ceramic material 2)Alloy of Ni/Cr/Fe/Si/B	1)31.3 HRC 2)51.8 HRC	Shot - Peening	–	–	–	Ra-Center line average value of roughness RPM-Height of the peak from the center	—	—	Shot – peening after coating shows improvement on abrasive wear resistance than steel blades due to coating , hardening
S.Kumar et al., 2000	Mild steel	Material used with three different chemical composition	1)705 HV 2)252 HV 3)250 Hv	1)Hardfacing 2)HVOF-Spraying	–	–	HOVF-Spraying	Suga abrasion tester	Change the composition in percentage of the material .Cr-used with 6.5%	–	The hardfacing alloy have highest Cr% in material , so wear rate decreases with

											6.5%
s.Selvi et al. , 2008	Low alloy steel or carbon steel	C and Cr	C – 160 HV and Cr- 325 HV	1)hardfacing 2)Hardenability	Baked in the electric oven at 200 degree celsius	—	Manual metal arc welding (MMAW)	1)wire EDM 2)Vickers hardness instrument 3)pin-on-Disk 4)Spectroscopic analysis used for calculation	1)E-430 2) Modified E-430 Stainless steel 3)E-410	–	Increase in Cr from 13.1 to 17.76 % Hardness increases , wear resistance increases using electrode E-430
V.M.Salokhe et al., 1999	Uncoated tines	Enamel – coated tines	–	Porcelin enamel coating technique	500 degree Celsius	–	–	Test in farm work in hours upto 30 hours	–	A Kubota 4-Cylinder Diesel Engine tractor Model L-3001	The enamel-coated tines gives better soil inversion , also reduces the wt. loss of tines by reducing soil friction
V.Shibe et al., 2013	Carbon steel substrate	Study various coating materials	Material with their hardness	Surface modification technique 1) Hardfacing 2)Thermal spraying 3)Cladding 4)Welding	—	—	SMAW, MIG, TIG ,SAW and PTAW etc. studied	Pin-on-Disk , Vickers Scale such various methods studied here	Studied various electrodes like EH-600, EH-350 and EH-14 Mn	—	Wear resistance of the material improved by many surface modification technique , Hardfacing improves overall performance of the material
A.Amirsadeghi et al. , 2008	Alloy steel	1)Carbides 2)Ledeburitic structure 3)Carbide and a eutectic matrix	1)855-1065HV 2)895 HV 3)1080	Laser beam , Electron beam	Specimens were Austenized at 900 degree Celsius And Austemp	–	TIG	Y-block method	1)Argon gas 2Tungesten electrodes	—	Surface melting increases the hardness upto 895 HV and decrease

			HV		ered at 350˚C.						s wear rate upto 37%
S.Kumar et al. , 1999	1) mild steel 2)Medium Carbon 3)Alloy steel	1)Hardfacing layer 2)medium carbon alloy steel 3)mild steel	1)705 HV 2)254 HV 3)162 HV	Hardfacing	—	—	Open Arc Welding Process	Suga abrasion tester	Hardfacing alloy	—	Hardfacing is very effective & Techno-economic solution to the wear problem of the material.
R.Dasgupta et al. , 1998	Plain carbon steel	Wear resistance hardfacing alloy	300 HV	Hardfacing	—	—	Manual Arc Welding (MAW)	1)Falex rubber wheel abrasion tester 2)RWAT , Three-body abrasion tester 3)Scanning electron microscopy	Hard facing alloys with Cr-6.5%	—	Hardfacing improves abrasive wear, resistance of steel & life, bulk hardness , subsurface work hardening, wear.

TABLE 2:

AUTHOR	BASIC MATERIAL	TYPE OF BLADE	CUTTING EDGE	SOFTWARE USED	MATERIAL NAME	ELASTIC MODULUS(N/mm2)	POISSON RATIO	DENSITY (Tone/mm3)	RESUTS
C.Manivelprabhu et al. , 2015	Cast iron and high carbon steel	L-shaped	Both side cutting edge	FEM , CATIA R-20 , Hypermesh 12.0 etc.	1)High carbon steel 2)cast iron	1)1.97 *10^11 2)1.20 *10^5	1)0.29 2)0.28	1)7.48 *10^-9	After obtaining the design of new blade , by using hyper mesh structural analysis done for old and new blade. So new blade gives better performan

									ce than old blade like stress manageme nt , life of blade etc.
S.K.Mandal et al. , 2013	High tensile steel and cast iron	L-shaped	Single side cutting edge	FEM , Ansys , CAD-Modeling , Simulation etc.	1)High carbon steel 2)cast iron	1)4.6*10^8 2)2.5*10^8	0.3	7.69*10^1 0	This research focuses on design optimizati on of tiller blades, L-shaped blades gives better performan ce and more working life.
A.Jeevarathin am et al. , 2014	High carbon steel , cast iron , mild steel	L-Shape d	Single side cutting edge	FEM, CAD-Software like -Ansys -CATIA -Pro-E, Hypermesh .	1)High carbon steel 2)cast iron 3)mild steel	1)1.97*10^ 5 2)1.20*10^ 5 3)2.10*10^ 5	1)0.29 2)0.28 3)0.30	1)7.48* 10^-9 2)7.28* 10^-9 3)7.89* 10^-9	In such project different material compositi on and dimension s taken for analysis & load condition is applied for existing and modified blades , it gives improved wear rate as well as increase the working hours of the blades.
G.U.Shinde et al. , 2011	Cast iron and High carbon steel	L-Shape d	Single side cutting edge	FEM , Simulation , CAD-Software etc.	1)High carbon steel 2)cast iron 3)mild steel	1)1.9*10^1 1 2)1.20*10^ 5 3)2.10*10^ 5	1)0.29 2)0.28 3)0.3	1)7.48* 10^-9 2)7.20* 10^-9 3)7.89* 10^-9	This present working model with tillage blade is analysed to new design constraints by changing

									geometry so that efficiency of blade increases successfully.
Dr.R.Yadav and R.G.Junagadh, 2016	High carbon steel	Hatchet type blade	Single side cutting edge	Solidworks, FEA, Ansys, CAD, CREO,etc.	High carbon steel	1.97*10^11	0.29	7.48*10^-9sss	In such study Hatched type blade of Rotavator carried out using Solidworks, Ansys Software, so max. Deformation obtained at 4.14 mm for this blade at given boundary conditions.

TABLE 3:

AUTHOR	BASIC MATERIAL	TYPE OF BLADE	CUTTING EDGE	BLADE RADIUS SIZE	BLADE DIMENTIONS	FORWARD SPEED	SOIL USED	TESTS	RESULTS
H.Fang et al., 2016	65 Mn	C-type	Single side cutting edge	225 mm	1)Length= 6 m 2)Width=2.5m 3)depth=0.5m	o.222 m/s	1)silt =47% 2) sand=11% 3)Clay =42%	T-test using SPSS	Study of Soil-tillage bladeintraction conducted under controlled conditions. Straw forward movement was larger than soil- straw movement. Single size straw would be better than straw mixture for soil displacement.
M.A.Matin et al., 2016	Bis-alloy hard wearing steel plate	c-type	Single side cutting edge	170.5 mm	1)Length= 3000 mm 2)Width= 1500mm 3)depth=450 mm	0.39-0.67 m/s	1)silt =59.2% 2)sand=25.8% 3)Clay =15%	Indoor seeding test rig and soil bin facility	This soil bin study examined the use of rotating straight blades with cutting edge 50 mm wide strip furrow., this study recommends inside chamfered blades and a small bite length of 20 mm strip-tillage.
M.A.Matin et al.,2014	Bis-alloy hard wearing steel plate	c-type	Single side cutting edge	170.5 mm	1)Length= 3000 mm 2)Width= 1500mm 3)depth=450 mm	0.67 m/s	1)silt =59.2% 2)sand=25.8% 3)Clay =15%	Indoor seeding test rig and soil bin facility	This study recommends the use of straight blades operated at the rotary speed of 375-500rpm with corresponding length 20-27 mm. straight blades would be easier to manufacture locally at village level.
M.A.Matin et al.,2015	Bis-alloy hard wearing steel plate	c-type	Single side cutting edge	170.5 mm	1)Length= 3000 mm 2)Width= 1500mm 3)depth=450 mm	0.67 m/s	1)silt =59.2% 2)sand=25.8% 3)Clay =15%	Indoor seeding test rig and soil bin facility	In such study the tiller blades tested under sandy loam soil in a soil bin and showed that the soil cutting torque varied during soil cutting, straight blade required low power, torque and specific energy as well as produce high quality seed-bed furrow. Also reduced power upto 20-25 %., easy & cheap manufacturing.

CONCLUSIONS & DISCUSSION

Wear resistance of the soil working tool like rotary tiller blades can be reduce by surface modification technique- Hard facing, Thermal spray coating, Shot peening, Vapor deposition, Electro deposition for wear resistance. Hard facing alloys increase the wear resistance and greatly reduce the ideal time for reinstating the Worn out blades, which in turn reduce the labor cost significantly. Cr- plating on the material with increase its percentage increases the life & wear properties of the material.

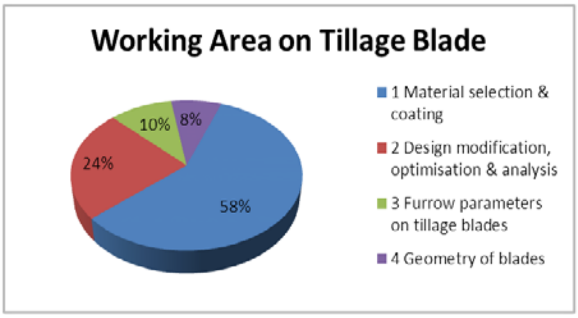

Fig: 1: Different working area on Tillage Blade from the paper cited in Literature servey.

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