IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 10, Issue 7 Ver. III (July 2017), PP 01-07
www.iosrjournals.org

Study of the Different Types of Sugar Cane Planter in India

[*]Manish Kumar[1], Ashok Tripathi [2]

[1] *Ph.D. Scholar; Farm Machinery and Power Engineering, Vaugh Institute of Agriculture Engineering and Technology, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad-211 007, UP, India*

[2] *Professor & Head; Farm Machinery and Power Engineering, Vaugh Institute of Agriculture Engineering and Technology, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad-211 007, UP, India*

Corresponding Author: Manish Kumar

Abstract: *Sugarcane (Saccharum officinarum L.) is an important cash crop and cultivated between 320N to 320S latitude covering more than 90 countries of the world. Sugarcane contributes about 64.6%of the total world sugar production. India is one of the greatest producers of sugar and has a neck-to-neck race with Brazil for the first position. The country shares about 13.25 percent of the World's and 41.11 percent of Asian sugar production and it is cultivated in 4.10 million hectares with annual production of 300.25 million tonnes of cane and 18.90 million of sugar. The sugar industry is an instrumental in generating the sizable employment in the rural sector directly and through its ancillary units. It is estimated that about 50 million farmers and their dependents are engaged in the cultivation of sugarcane and about 0.5 million skilled and unskilled workers are engaged in sugar factories and its allied industries. Wheat-sugarcane-Raton cropping system is followed in whole of western Uttar Pradesh and lower parts of Uttrakhand where sugarcane is the main cash crop and wheat is the major cereal. The system accounts for more than 60% of the total cultivated area in the region. However, lower average yield of planted cane (50 tonnes/ha) recorded in this. The reduction in cane yield owing to delayed planting cannot be compensated by additional inputs viz., frequent irrigations, extra fertilizers and inter culture operations. In order to achieve uniform crop stand, correct seed rate, appropriate depth of setts placements and uniformity of setts with required overlapping are important. These, however can better be achieved by using tractor-drawn sugarcane cutter planter apart from economising labour and energy. Also there is a need to evolve proper tillage techniques for early planting of sugarcane in wheat-sugarcane crop sequence. In this paper we studied the performance of the different types of sugarcane cutter planters used in India for the purpose of our research. The main objective of the research is the study of the different sugarcane planters used in India*

Keywords: *Wheat harvesting; Pre and Post irrigation; Sugarcane cutter planters; Rigid; slit; disc and furrower planter*

Date of Submission: 28-07-2016 Date of acceptance: 26-07-2017

I. Introduction

Paper Cultivation of sugarcane in India dates back to the Vedic period. Barber (1931) was of the opinion that the thin Indian canes probably originated in the moist parts of north eastern Indian, from some plants closely related to *Saccharum spontaneum* (Kans). It belongs to family Gramineae (Poaceae), class monocotyledons and order glumaceae sub family panicoidae, tribe Andripogoneae and sub tribe saccharininea. The cultivated canes belong to two main groups: (a) thin, hardy north Indian types *S.barberi* and *S.Sinense* and (b) thick, juicy noble canes *Saccharum officinarum*. Highly prized cane is *S. officinarum*. It is probably evolved from *S. robustum* by introgression from other genera. It is agreed that the origin of S. officinarum is the Indo-Myanmar china border with New Guinea as the main centre of diversity. The process of nobilization in sugarcane is the modified back crossing of wild cane. *S. spontaneum* with *S. officinarum* and a repeated back crossings to the noble parent (*S. Officinarum*). It is stated that the cradle of cultivated sugarcane is the region where two wild species i.e., S*accharum spontaneum* and S*accharum robustum* are found. S*accharum robustum* is derived from natural crossing between S*accharum spontaneum* and *Miscanthis floridulus* and the origin is New Guinea. Sugarcane is one of the most important food-cum-cash crops in India. Sugarcane (Saccharum officinarum L.) is an important cash crop and cultivated between 320N to 320S latitude covering more than 90 countries of the world. Sugarcane contributes about 64.6%of the total world sugar production. India is one of the greatest producers of sugar and has a neck-to-neck race with Brazil for the first position.The country shares about 13.25 percent of the World's and 41.11 percent[1,2,3] of Asian sugar production and it is cultivated in 4.10 million hectares with annual production of 300.25 million tonnes of cane and 18.90 million of sugar**.** The

average yield of the crop is about 85.5 tonnes/ha [4, 6], which is lower than the average productivity of Australia, Indonesia, Colombia, etc. In India, Sugarcane crop is grown between 70 to 320 latitude covering large variations in climate, soil crop spread and productivity. The major area under this crop lies in subtropical belt comprising U.P., Uttaranchal, Bihar, Punjab, Haryana, Rajasthan and Madhya Pradesh [5, 7, 8]; which accounts for about 70% of the cane area and 50% of the cane production. Uttar Pradesh and Uttaranchal states collectively contribute 49.74% of the total cane area and 44.34% of the total cane production in India. Sugarcane is the raw materials of sugar industry and the main source of white sugar and jaggary (locally called *'gur'*). At present, the area under sugarcane in India is about 130 thousand hectares covering both mill and non-mill zones with an annual production of about 162 thousand tones of sugar and 310 thousand tones of '*gur'* (BBS, 2008) as against the current requirement of 1820 thousand tones estimated at 13 Kg of sugar or 17 Kg of *'gur'* per capita per annum (FAO, 1982). Therefore, there is an annual deficit of 1348 thousand tones of sugar and *'gur'*. As a result, the country's requirement is met by importing sugar spending huge amount of hard earned foreign currency. To improve this situation and stop drainage of foreign currency, there is an urgent need to increased the country's sugarcane production from the current level of around 4,984 thousand tons (BBS, 2008) to 19,218 thousand tones per year. The soil and climate of India are very much conducive to obtain maximum yield of sugarcane.

Sugarcane is a most important cash crop of India. It involves less risk and farmers are assured up to some extent about return even in adverse condition. In agriculture sector, sugarcane shared 7% of the total value of agriculture output and occupied 2.6% of India's gross cropped area during 2006-07. Sugarcane provides raw material for the second largest agro-based industry after textile. About 527 working sugar factories were located in the country during 2010-11 with total crushing capacity of about 242 lakh tonnes. The sugar industry is an instrumental in generating the sizable employment in the rural sector directly and through its ancillary units. It is estimated that about 50 million farmers and their dependents are engaged in the cultivation of sugarcane and about 0.5 million skilled and unskilled workers are engaged in sugar factories and its allied industries. The sugar industry in India has been a focal point for socio-economic development in the rural areas by mobilizing rural resources, generating employment and enhancing farm income. Some of the sugar factories have also diversified into bye-products basis industries and have invested and put up distilleries, organic chemical plants, paper, ice board factories and cogeneration plant.

In India, sugarcane productivity has increased over the years but the magnitude has been very small. A wide gap exists between the potential and the realized productivity largely due to environmental constraints. In sub tropics, soil moisture during germination phase is usually low, resulting in poor sprouting of buds. Likewise, drought during the formative phase leads to poor till ring and elongation of shoots. Extremely low temperature at ripening stage impairs sucrose accumulation adversely affecting sugar and sugarcane productivity [18,19, 20]. On account of social taboos and other factors, farmers in north India take sugarcane after harvest of Rabi crops such as wheat, lentil, gram and mustard etc. which results in low yield. Planting sugarcane late in April or May after wheat harvest causes poor germination and does not allow enough period for till ring, resulting into less mill able canes and low cane yield.

II. Origin And Historical Background

Based on abundance of genetic diversity of germplasm of Saccharum and its relatives and also cytogenetical and morphologic potential in the north-east region of India bordering Burma and China is believed to be the place of origin of Saccharum officinarum. The contention of Indian origin of sugarcane is ruled out with the lack of intermediate wild clone, such as S. robustum in India by Daniels and Roach (1987). New Guinea and the adjoining Island chains of Indonesian Archipelago are the two major centres of diversity for S. officinarum and S. robustum. S. robustum (2n = 60, 80) is believed to be the wild progenitor of S. officinarum (2n = 80). S. robustum, distributed naturally from New Hybrids through New Guinea and Indonesia to Mindanao (Philippines) was believed to have evolved through introgression of S. spontaneum, Erianthus and Miscanthus. S. spontaneum (2n = 40 to 80) another wild species is distributed mainly in areas from Afghanistan (in west) to Malay Peninsula, Taiwan and South Pacific Island (In East) [21, 20]. Based on cytological evidences, it is believed to have originated from introgression between Erianthus and Sclenostachya. The cultivated S. barberi is believed to have evolved through selection of S. spontaneum or through hybridization of S. officinarum and S. spontaneum in Bengal-Bihar-Orissa region of India. Tropical cane might have originated in some of the larger Islands of Oceania, most probably in New Guinea. Brandas (1956) also concluded that it was originated in New Guinea, where various forms of thick, tall, tropical canes have been cultivated from ancient times. From India, it probably entered into China, Arabia and Egypt and after the crusades, it was introduced in Sicily, Portugal, the Canary Islands state into the new world. Kalbagal (1956) studied the influence of planting time on cane yield in Mysore reported that crop planted in the month of November and December produced significantly higher yield of 87.5 and 86.9 tonne/hectare, respectively than that of late planting. Vaidyanathan (1957) under southern condition (TamilNadu) observed that early January planting gave

significantly higher cane yield of 106.5 tonne/hectare than that of Mayand September planting. Panje et al. (1965), while studied the sugar cane germination under different planting season at IISR, Lucknow found that October plant crop exhibited higher germination than February planted sugarcane. Paltooram (1970), reported that under Tarai conditions of Utter Pradesh February plant sugarcane recorded higher germination (46.90%) than that of October planted sugarcane (40.20%). Fasihi and Malik (1974), from Pakistan reported that cane planted in the month of October gave significantly higher yield of 74tonne/hectare than that of planting in November, December, January, February and March. EI-Sharkawy and Sgaier (1975) found that as compared to no tillage, disking to 15-34cm depth and sub soiling to 50cm and 70cm depth increased rooting depth by 24,48,100 and 132% ,respectively. Krall et al.(1978) and Payton et al. (1985) reported that double disc opener allowed straw to flow more smoothly and created more favourable seedbed than spear point and soil types in no till drill. Odigboh and Akubno(1990) reported that ridgers having mouldboards require more power to pull than those with disc. Shukla et al. (1978) developed a rotadurem sugarcane planter, which required two workers to feed the cane setts and a tractor operator. Preliminary test indicated that the field capacity of the machine was approximately 2 ha/day.

III. Materials And Methods

A. Details of sugarcane cutter planter used for experimentation

(i) Method of planting

Sugarcane can be planted by improved method of planting like, deep furrow, trench methods, ring pit method and paired row method instead of furrow system. According to methods of planting, four types of the sugarcane cutter planters having ridger, slit, furrower and disc furrow openers were used for conducting the experiment. The technical details and specification are described below.

a) Ridger type sugarcane cutter planter

This planter basically consists of 1650 mm long and 780 mm wide rectangular frame made of 60 ×60×60mm angle iron on which two ridger are mount with a provision to adjust row to row spacing from 750 to 900 mm. Two speed hoppers, each having cane capacity of 125 kg and length, width and height of 570, 380 and 1380 mm respectively were mounted on the main frame which are made of 1.6mm thick M.S. sheet. Insecticide tank of 16 liter capacity having dimensions of 710×250×210mm is mounted on the frame. Another tank of 16 liter capacity is provided for the use of fungicide. It has two fertilizer boxes with star wheel type agitators along with circular plate having three sizes circular openings to meter the quantity of fertilizer. These boxes were made of trapezoidal shape having a cross section of 470×300 mm at the top 160×60 mm at the bottom with 350 mm height.

Table 1: Physiochemical properties of experimental fields

Sr. No.	Property	Year		Method used
		2014	2015	
1.	Composition (I)Coarse sand (%) (ii)Fine sand (%) (iii) Silt (%) (iv)Clay (%)	 0.56 59.10 25.27 15.13	 0.55 59.32 26.78 14.73	 International pipette method
2.	Textural class	Sandy loam	Sandy loam	
3.	Initial Bulk density (g/cc)	1.35	1.37	Core sample method
4.	Electrical conductivity (d Sm^{-1})	0.26	0.24	Conductivity bridge
5.	Soil pH (1:2:5)	7.50	7.55	Beckman glass electrode pH meter
6.	Organic carbon (%)	0.38	0.37	Modified Walkley and Black method
7.	Available Nitrogen (kgN/ha)	199.5	203.2	Modified Kjeldahal Method
8.	Available phosphorus (kgP_2O_5/ha)	32.17	32.47	Olsen's method
9.	Available potassium (kg K_2 O /ha)	289.0	286.01	Natural normal ammonium acetate method)

The capacity of fertilizer box is approximately 25 kg. The tractor PTO through a chain and sprocket drive operates the fertilizer metering system. The sett cutting mechanism consists of two cutting units, one of each row. Cutting unit consists of two revolving knives place at 180^0 apart and mounts on 150 mm diameter solid M.S. disc having 10 mm thickness. The length, width and thickness of each knife are 170 mm, 5mm and 3 mm respectively. The power is transmitted from tractor PTO to the cane cutting mechanism through universal joint and a set of bevel pinion and gear.

b) Disc type planter sugarcane cutter planter

This planter consists of two 65 cm diameter discs, which are configured, and installed so as to produce V-shaped furrows. The discs are tilted vertically at an angle of 150and having a disc angle of 200. Spacing between discs can be adjusted to obtain 750mm to 900mm row to row spacing. The cane cutting mechanism consists of two counter rotating blades. The blades are sharpened downward to prevent upward thrust on sugarcane stalks, which are held by laborers during planting operation. There are two seats for two persons to be engaged for feeding the sugarcane.

c) Slit type planter sugarcane cutter planter

Instead of disc type furrow opener as described in previous sugarcane cutter planter, slit type furrower are used for making narrow furrows for cane planting. These are made from flat pieces of carbon steel welded together to form a cutting edge and bolted to the two points of rectangular cross section steel shank of size 3x1.5mm.

d) **Furrower type sugarcane cutter planter**

This Design employed a furrower for furrow opening. The power transmission for sett cutting is through PTO of tractor. The planter have insecticides tank, fungicide tank and fertilizer box and have overall dimensions 2.18×2.80×3 m. It is heavier than other planters (550 kg) and it has insecticide tanks capacity of 100 liters and capacity of seed box is about 130 kg.

Table 2: Technical specifications of sugarcane cutter planters

SI. No.	Particulars	Specification
1	Source of power	Tractor
2	Power transmission	Ground wheel (Disc and slit type) P.T.O.(Ridger and Furrower type)
3	Overall dimensions	
	Length, m	2.035
	Width, m	1.852
	Height, m	2.25
4	Weight, kg	Ridger(420), Disc(425), Furrower(550) and Slit (410)
5	Type of hitch	3 point (mounted)
6	Furrowers used	Ridger, Disc, Furrower and Slit type
7	Capacity of insecticide tank, l	Ridger(16), Disc(20), Furrower(100) and Slit (25)
8	Capacity of fungicide tank, l	Ridger(16), Disc(22), Furrower(40) and Slit (30)
9	Capacity of fertilizer box, kg	Ridger(25), Disc(35), Furrower(45) and Slit (30)
10	Row to row spacing, cm	Adjustable within 75.0-90.0
11	Capacity of seed box, kg	Ridger(125), Disc(124), Furrower(130) and Slit (126)
12	Dimension of seed box	
	Length, cm	35.0
	Width, cm	55.0
	Height, cm	139.25

e) Tractor operated two row ridger type sugarcane cutter planter

In this planter, the perform operations involved in cane planting are sett cutting; furrow opening; placement of seed setts, fertilizer and chemicals; soil covering over setts and tamping of soil, in a single pass. It is tractor operated equipment mounted with three point linkage. The equipment is hydraulically controlled for its lifting and lowering. Power is derived through tractor PTO for operations of sett cutting and fertilizer metering while tractive power is used for other operations [16,28].

Source of Power: 35 HP tractors

Effective field capacity: 0.20 ha/h

Labor requirement: 4

f) Tractor operated two row multipurpose sugarcane cutter planters

Perform operations involved are sett cutting; furrow opening; placement of seed setts, fertilizer and chemicals; soil covering over setts and tamping of soil, in a single pass but the planting is done for two rows simultaneously. Power is derived through tractor PTO for operations of sett cutting and fertilizer metering etc "[16,18,26]".

Source of Power: 35 HP tractor

Effective field capacity: 0.25 ha/h
Labor requirement: 4

g) Julien planter
This planter is utilized as opening and closing fingers on a continuous chain that would grab the stalks laid flat in the wagon and discharge them into the previously opened planting furrow [16,18,28].

h) Slat Type Mechanical Planter:
In this design, a parallel set of chains replaced the drum. Metal slats that hold the stalk feeding rakes are laid across the chains. A larger circumference-metering device can be utilized with this design as compared to the conventional drum.[26,28,35]

i) Self Propelled two row Billet Planter :
This planter receives, transports and plants the seed cane. The planter tills the soil with furrow and also covers the seed cane with loose soil. Ridge-forming and fertilizer application is carried out by another tractor [35,36,38].

j) Bonnel Mechanical Planter :
This planter is fed by two men who introduce whole stalk cane into the cutting mechanism. The billets fall into the furrow, that is opened by the machine; a special device covers the furrow and a press wheel at the rear presses soil over the billets [32,35,37].

IV. Proposed Methodology

In the proposed methodology we conduct a study on is The Performance and Effects on Production of Sugarcane by using Different Types of Sugarcane Planter after Wheat Harvesting. For the research has been conducted in the Fauladpur village, of Dhanaura Block in Amroha district of Uttar Pradesh state. The studies of the performance and effects on production of sugarcane by using different types of sugarcane planter after wheat harvesting.

After harvesting of wheat by combine harvester straw left in the field was completely burnt. A main plot of 104.6m×53.3m has taken, in which a main irrigation channel and four sub irrigation channels of width of 1m and 0.5m respectively. The whole experimental field was divided into six blocks of 8m x 100m size having homogenous field condition and each block was further divided in 10 equal parts of 8m x 10m size to accommodate sub plot treatments, different types of cutter planter with three replications. In conventional tillage treatment, field was prepared by 1 ploughing + 2 harrowing and 2 rotavator operations and there after tractor drawn leveler was used.The details of experiment are given below:

Table 4: Experimental plan

Sl. No.	Particulars	Symbol
A.	Irrigation (I)	
	I. Pre- planting irrigation	I_1
	II. Post- planting irrigation	I_2
B.	Tillage (T)	
	I. Conventional tillage(1 ploughing + 2 harrowing)	T_1
	II. Tillage operation by rotary tiller (2 rotavator)	T_2
C.	Planters (P)	
	I. Conventional practice (tractor operated ridger) (control)	P_0
	II. Disc type sugarcane cutter planter	P_1
	III. Silt type sugarcane cutter planter	P_2
	IV. Ridger sugarcane cutter planter	P_3
	V. Furrower sugarcane cutter planter	P_4

Statistical design : RBD (Factorial 2 x 5 x 2)
Treatment combinations : 2 x 5 x 2=20
Plot size : 10 mx8m = 80 m^2
Total length of field : 104.60 m
Total width of field : 53.3 m
Gross area : 104.60 m x 53.3m = 5575.18 m^2
Net area : 100 m x 48 m = 4800m^2
Inter row spacing : 80 cm
Main irrigation channel width : 1 m
Sub-irrigation channel width : 0.5 m
Total no. Sub-irrigation channel : 4

Bunds width	:	0.3 m
Total no. of Bunds	:	12
Sugarcane variety	:	COS-767

Testing procedure

The same testing procedure was adopted for first as well as second experiment. The sugarcane seed variety COS-767, was kept at both ends as well as in the middle of the experimental plot to ensure regular and smooth seed availability for the planter so as to minimize seed filling time during planting. Massey 241 tractor was used in II low gear at 2000 and 1500 engine rpm during first and second experiment respectively. Two persons were employed for feeding the canes into sett cutting units. The distance travelled in 8 revolution of tractor and 13 revolution of ground wheel was measured separately to determine the tractor wheel slippage and ground wheel skid respectively. Time taken to cover the distance of 73m in first and 48m in second experiment were measured respectively.

V. Conclusion

After the observation of the performance of the different types of the sugarcane cutter planter, we observed that the rigid type of cutter planter is good in all terms and it is also used by many farmers but we also want to know that which planter gives the best result in terms of productivity, energy consumption and the economical point of view for the purpose of sugarcane plantation after wheat harvesting. This is also the main objective of our proposed research.

References

[1]. Kumar Manish, Tripathi Ashok, 2015. "To Study of the Different Modes of Tillage for the Performance of Sugarcane Cutter Planter". International Research Journal of Engineering and Technology (IRJET) Volume: 02 Issue: 03 | June-2015 e-ISSN: 2395 - 0056 p-ISSN: 2395-0072.

[2]. Anonymous.1977. Extending crushing season of sugar cane. Annual Report Indian Institute of Sugarcane Research . Lucknow. pp.11-13.

[3]. Anonymous.1997. Indian J. Agron., Vol.42(4):pp.657-660, December,1997.

[4]. Anonymous .1999. Indian sugar . The Indian Sugar Mills Association.XL:475-476.

[5]. Anonymous.2001. Indian sugar . The Indian Sugar Mills Association.XLIX:222-224.

[6]. Anonymous.2001. Productivity constraints. The Hindu Survey of Indian Agriculture. pp.97-102.

[7]. Bachloo,S. 1984. Studies on planting and harvesting schedule of sugarcane varieties

[8]. Bahri, A. and Bansal, R. K. 1992. Evaluation of different combination of openers and press wheels for no-till seedlings . In: Tillage in arid and semi-arid areas, Seminar on Agricultural Engineering, Rabat Morocco, April 22-25, 1992, (c.f.liter.upto date on wheat, 1995. Vol.1(3):pp.2270)

[9]. Baker, C. J. 1983. Some developments in direct drilling equipment in New Zealand. Agric. Mech. in Africa and Latin America.Vol.14(4):pp.25-30.

[10]. Baker, C.J.; McDonald, J.H.; Rix, C. S.; Seebeck, K. and Griffiths, P. M. 1979. Development with seed drill coulters for direct drilling an improved chisel coulter with trash handling and fertilizer placement capacities .N.Z.JI.Res.Agric.,7:pp. 189-196.

[11]. Barnes,P.L. and Maddux,L.D.1991. Tillage system effects on soil physical properties . American. soci. Agril. Engg., No. 91-2627, 19 p.

[12]. Bernacki,H.;Haman, J. and Kanafojski, C.Z. 1972. Agriculture machines, theory and construction. National technical Information service, Warsaw: 203-205.

[13]. Bhatt,V.K. and Pandey , M.C. 1982. Modification and testing of sugarcane planter. Unpublished, B. Tech. Dissertation, G.B. Pant University of Agriculture and Technology, Pantnagar , Uttaranchal .

[14]. Black, C.A. 1971. Methods of soil analysis –Part 2. Am. soc. Agron. Inc. Publisher, Madison, Wisconsin. USA.

[15]. Borin , M. and Sartori, L. 1995. Barley, soybean and maize production using ridge tillage, no –tillage and conventional tillage inn north east Italy. J. Agric. Engg. Res. 62:pp.229-236.

[16]. Bouyoucos, G.j. 1972. Hydrometer method improved for making partical size analysis of soils. Agron., J. 54:pp.464-465.

[17]. Brenner, J.M. and Mulvaney, C.S. 1982. Nitrogen total . In: Page, A.L.; Miller, R.H. and Kineey, Dr. (Eds) Methods of soil analysis part 2 American society of Agronomy, Inc. soil science Soc. America. Inc., Madison , Wisconsin, USA. pp. 595-624.

[18]. Choudhary, A.d.: Baker, C.J, and Springett, J.A. 1990. Direct drilling (no- till) opener design specification and soil micro and environmental factors to influence barley seedlings establishment in a wet soil . In: International Congress on Mechanization and energy inn agric. Conference, Adana, Turkey at October 1-4, 1990. pp. 201-211.

[19]. Choudhary, M.A. 1988. A new multi crop inverted- T seeder for upland crop establishment. AMA, Vol.19(3):pp.37-42

[20]. Choudhary, M. A. and Baker, C. J. 1980. Physical effects of direct drilling equipment on undisturbed soil. Wheat seedlings emergence from a dry soil under controlled climates. N.Z. JI. Agric. Res., 23:pp. 489-496.

[21]. Choudhary, M. A. and Baker, C. J. 1981. physical effects of direct drilling equipment on undisturbed soil. Wheat seedlings performance and ingroove micro-environment in a dry soils. N. Z. JI. Agric. Res., 24: pp.189-195.

[22]. Choudhary, M. A. and Baker, C. J. 1982. Effect of direct drill coulter design and soil moisture status on emergence of wheat seedlings. Soil and Tillage Res., 2 :pp. 131-141.

[23]. Deshpande, S.B.; Fahrenbacher, J. B. and Ray, B. W. 1971. Mollisols of Tarai region of Uttar Pradesh, Northern India. II. Genesis and classification. Geoderma, 6:pp.195-201.

[24]. Ellis, F. B.; Elliott, J. g.; Pollard, F.; Cannel, R.Q. and Barneo, B.T. 1979. Comparison of direct drilling, reduced cultivation and ploughing on the growth of cercals, winter wheat and spring barley on calcareous soil. J. Agric. Sci.; 93:pp.391-401.

[25]. EI-Sharkawy, M. A. and Sgaier, k. 1975. Effect of tillage on root penetration and grain yield of maxi an wheat(triticum aestivum L.) grown in Libyan Desert. Libyan J. Agric., 4:20-28.

[26]. Fashili, S. and Malik, K. 1974. Effect of sowing on the yield and quality different sugarcane varieties. Agric. Pakistan Vol.25(3):pp.151-158.

[27]. Fink, J.T. and Currence, H. D. 1995. No- till drill utilizing adjustable seed furrow openers . appl. Engg. Agric., Vol.11(6): 811-816.
[28]. Fyre, W. W. and Lindwall, C. W. 1986. Zero tillage Research priorities . Soil and tillage Research, 8:pp. 311-316.
[29]. Gangwar, K. S. and Sharma, S. K. 1997. Simultaneous planting of sugarcane (saccharum officinarum) and wheat (triticum aestivum) for higher productivity and profitability of sugarcane –wheat system . Indian J. Agron.,Vol. 42(4):pp. 657-600.
[30]. Gee-clough, .D.; McAlister, M. and Evernden, W. 1977. Tractive performance of tractor drive tires. I. The effect of lug height, J. Agric. Engg. Res., Vol.22(4): pp.373-384.
[31]. Gupta, D. K. 1989. Soil management for wheat crop after paddy harvesting thesis, M. tech. G. B. Pant University of agriculture and technology, Panthnagar.
[32]. Payton, D. M.; Hyde, G. M. and Simpson, J. B. 1985. Equipment and methods for no-tillage wheat planting. Trans ASAE.Vol. 28(5) :pp. 1419-1424, 1429.
[33]. Shukla, L.N.; Sharma, M.P. and Verma, S.R. 1984. Development of a sugarcane planter for developing countries. Agric. Mech. In Asia, Africa and Latin America, Vol.15(1) : pp.33-42.

*Manish Kumar. "Study of the Different Types of Sugar Cane Planter in India." IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 10.7 (2017): 01-07.