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A review on development and evaluation of okra planter

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Abstract
India is the second-largest producer of fruits and vegetables in the world. Okra (*Abelmoschus esculentus* L.), is an economically important vegetable crop in India with the potential to increase farm incomes. Being the leader in Okra production and producing 66.30% of the World's okra. However, Manual method of seed planting, results in low seed placement, spacing efficiencies and serious back ache for the farmer which limits the size of field that can be planted. A review on advanced method of planting of okra seed is summarised from researches developed improved tools and planters which suits to the farming community. Proper selection of manually and tractor operated planter sowing for okra seed is cheap, easily affordable by the rural farmers, easy to maintain and less laborious to use in order to reduce tedious and drudgery, improve timeliness and efficiency of various farm operations, bring morel and under cultivation, preserve the quality of agricultural produce, provide better rural living condition and markedly advance the economic growth of the rural sector tractor operated planter also be used.

Keywords: Okra, okra planter, two row okra planter, vegetable planter, efficiency

1. Introduction
India is the second-largest producer of fruits and vegetables in the world (Anon., 2017) [3]. Okra (*Abelmoschus esculentus* L.), is an economically important vegetable crop in India with the potential to increase farm incomes. The place of origin is Ethiopia, it is mainly grown in tropical and sub-tropical regions. India produced 6146 thousand metric ton of Okra in 528 thousand ha with average productivity of 11.6 metric ton/ha during 2016-17 (Anon., 2017) [3]. The major growing states in India are Uttar Pradesh, Bihar, West Bengal and Orissa. Okra is mainly grown for its green tender nutritive fruits. Dry fruits and skin are useful in paper industry and fiber extraction. Okra is rich source of vitamins, protein, calcium and other minerals.

In India sowing time of okra varies from region to region due to geographical diversity. Okra transplanting is not practiced and broadcasting leads to more seed consumption. Thus, a seed is sown directly in the soil by seeding behind the plough or dibbling, or with the seed-drills. In this seeding method, it is not possible to achieve uniformity and distributions of seed expect dibbling. Whereas, dibbling is one of the expensive sowing methods. The inter-row and intra-row distribution of seed are likely to be uneven resulting a seed cluster or gap filling requirement. The input use efficiency and plant establishment of the most vegetable crop were poor. As a result, the yield and product quality are low and cost of cultivation is high. Besides this, the seed coat of okra was very hard and it does not take up water easily after sowing in the soil, this resulted in very poor germination. Hence, to increase a germination percentage of okra generally a soaking of okra seed in water for 24 hours is very common practice in India (Anon 2015, Yawalkar, 1992) [2]. Moreover, conventional seeding machines do not maintain precise plant spacing and seed rate (Khambalkar *et al*., 2014) [11]. Manual method of seed planting, results in low seed placement, spacing efficiencies and serious back ache for the farmer which limits the size of field that can be planted. This method of planting is labor-intensive and can benefit considerably from simple mechanization (Bamiro *et al*., 1986) [7].

Farm mechanization is the use of mechanical wheels or systems to replace human muscle in all forms and at any level of sophistication in agricultural production, processing storage and so in order to reduce tedium and drudgery, improve timeliness and efficiency of various farm operations, bring more land under cultivation, preserve the quality of agricultural produce, provide better rural living condition and markedly advance the economic growth of the rural sector (Anazodo, 1986) [1].

The cost price of imported planters has gone beyond the purchasing power of most of our farmers. Peasant farmers can do much to increase food production especially grains, if drudgery can be reduced or totally removed from their planting operations. To achieve the best performance from a seed planter, the above limits are to be optimized by proper design and selection of the components required on the machine to suit the needs of crops. This review work focused to take up information on the design and fabrication of a manually operated planter sowing for different crop seed that is cheap, easily affordable by the rural farmers, easy to maintain and less laborious to use. The multi-crop planter has the capability of delivering the seeds precisely with uniform depth in the furrow and also with uniform spacing between the seeds (Khan *et al*., 2017) [10].

In recent years, different scientists evaluated prototypes to lessen the human drudgery in planting operation and to increase the farm productivity. A two-row okra planter developed from locally available materials was able to effectively place maximum of two seeds per hill. Bamgboye and Mofolasayo (2006) [6]. It had field capacity of 0.36 ha hr^{-1} with average field efficiency of 71.75%. Gupta and Herwanto (1992) [9] designed and fabricate a direct paddy seeder to match a two-wheel tractor. The machine had a field capacity of about 0.5 ha h^{-1} at a forward speed of 0.81 ms^{-1}, and there was no damage caused by the metering mechanism for soaked seeds; though 3% damage was recorded for pre-germinated seeds. Molin and Agostin (1996) [14] developed a rolling planter for stony conditions, using 12 spades radially arranged with cam activated doors and a plate seed meter. Improvement in the planting operation with reduction in human effort, more accurate stands and high field capacity. Kumar *et al*. (1986) [12] developed a manually operated seeding attachment for animal drawn cultivator. The seed rate was 43.2 $kg.h^{-1}$ while the field capacity was 0.28 ha h^{-1}. Test revealed minimal seed damage with good performance for wheat and barly. Ladehinde and Verma (1994) [13] compared the performance of three different models of planters with the traditional method of planting.

A large number of planters are available for cotton, maize, soybean, groundnut, and pea (Sahoo and Srivastava, 2000) [15]. The Okra seed coat is relatively hard compared to other vegetable seeds (Anon., 2015; Yawalkar, 1992) [2]. Hence, 24-hour water soaking is a common practice to enhance the germination percentage. These soaked seeds are more susceptible to seed damage.

Okra cultivation has been limited to manual planting, which is very tedious and laborious. Therefore, it is need to develop a simple tool that will be used in planting okra seeds. This work is aimed at review is given on manually operated okra seed planter and power operated planter designed by the scientist and authors to alleviate the burden of okra planting.

2. Materials and Method

A review on design and development of okra planter for different source of power viz.; manual and tractor drawn okra planters were carried out at the Department of Natural Resource Management, College of Horticulture, Bidar, Karnataka state, India.

2.1 Engineering properties of the okra seed

Engineering properties of the okra seeds plays important role for design of okra planter. (Badgujar *et al*., 2017) [4] determined engineering properties of okra seeds for development and evaluation of inclined plate metering mechanism. The engineering properties of two seed varieties of okra in soaked conditions (Fig.1) i.e., Pusa A4 which was recommended for all India sowing and Punjab-state were studied to design the metering plate for inclined plate planter Table1. The planter is designed according to seed dimension such as length, breadth, thickness and roundness of seed.

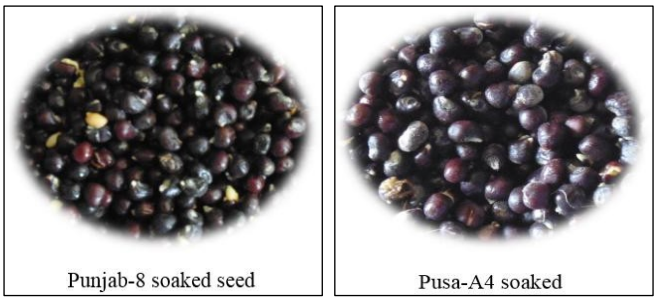


Fig 1: Soaked okra seed variety used for evaluation of metering mechanism

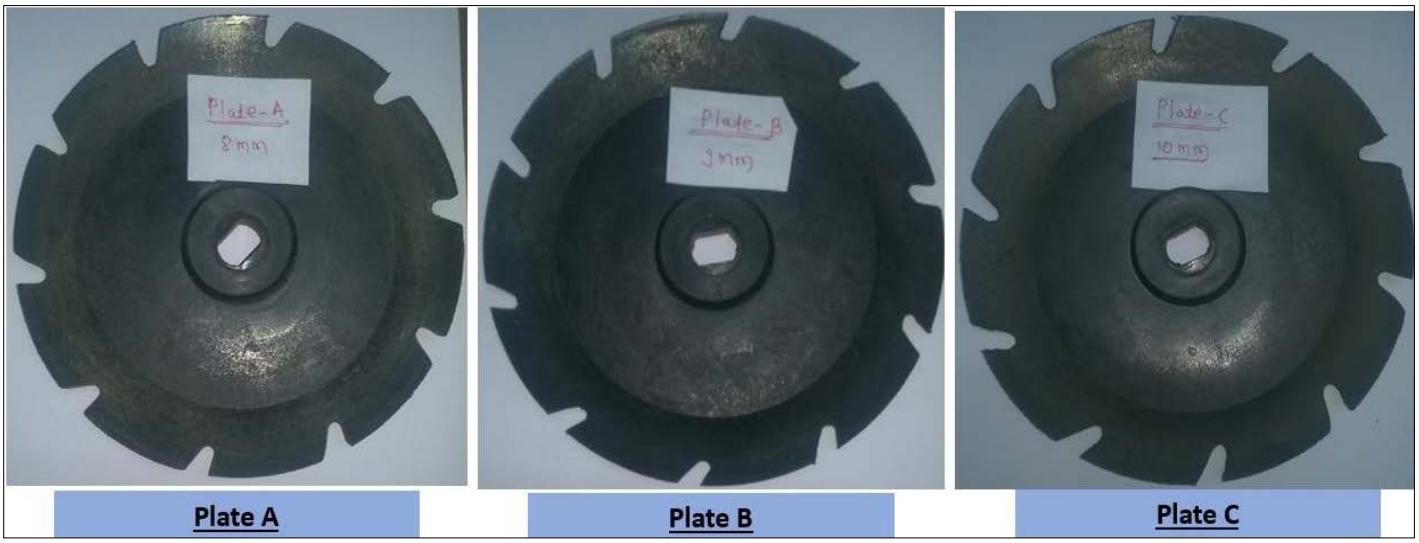


Fig 2: Metering plates used for metering of soaked okra seeds

Table 1: Engineering properties of soaked okra seed

Properties	Variety	
	PusaA-4	Punjab-8
Length, mm	6.61±0.43	6.34±0.51
Breadth, mm	5.70±0.60	5.37±0.39
Thickness, mm	5.08±0.43	4.70±0.35
Geometric Mean Diameter	5.76±0.32	5.42±0.26
Sphericity	0.87±0.05	0.85±0.06
Roundness	0.85±0.07	0.86±0.06
Angle of repose	31.24±1.25	33.30±0.78

The okra planter (Fig 3) tested was developed by Bamgboye and Mofolasayo, (2006) [6] University of Ibadan, Nigeria. The okra planter consists of: the feed hoppers, metering discs and housing, drive wheels, discharge spouts, furrow opening and covering devices, and the handles.

1. **Feed hopper:** There are two feed hoppers made of mild steel, each having a square cross section. The design capacity of each hopper is 1740000 mm^3. This capacity is based on the volume of seeds required to plant a hectare of land. The dimension of the hoppers is 84mm x 84mmx 300mm.
2. **Metering discs:** The metering discs or flutes are made of *Ayan* wood, because of its durability, high strength, and resistance to shrinkage. On each flute are two cylindrical cells bored, equidistant from each other along the periphery. The dimensions of the cells are 6 mm diameter and 10 mm deep.
3. **Drive wheels:** The drive wheels are made of mild steel and are integral parts of the seed metering mechanism. The wheels have spindles that bear keys that rotate the metering devices. The diameter of the wheels is 30 cm and spokes of 130 mm long cut from 10 mm diameter iron rod were welded to the wheel and the periphery of the bushing which suspends the shaft.
4. **Metering disc housing:** The material used for the construction of the two metering discs housings is a mild steel hollow pipe, 109 mm internal diameter and 50 mm long. Two slots (100 x 25 mm) were made at the upper and lower portions on each of the metering housing.
5. **Discharge spouts:** The discharge spouts essentially have a trapezoidal shape that links with a short cylindrical pipe from which the seeds drop into the furrow.
6. **Furrow opening device:** The furrow opener is a 40 mm mild angle iron with a length of 120 mm. The angle iron is slightly leveled at the lower edge to facilitate an easy cut through the soil. To facilitate the attachment of the furrow-opening device to its support, a pipe of diameter 17 mm (3/4") and 25 mm long was drilled to accommodate an 8 mm diameter bolt with the nut welded on the periphery of the hole drilled. The pipe was then welded at the underside of the top portion of the furrow opening device.
7. **Furrow covering device:** The furrow covering device is made of rectangular mild steel plate of dimension 95 mm x 130 mm. The pipe for attachment to the support was welded to the middle of the upper edge of the plate. The covering device is inclined at an angle of 45° to the direction of travel for optimum covering of the soil.
8. **Handle:** The handle consists of two mild steel pipes of 17 mm internal diameter, each of length 1230 mm. At the two ends of each of the mentioned pipes, two bushings each of 21 mm internal diameter and 30 mm long were welded in a horizontal position.

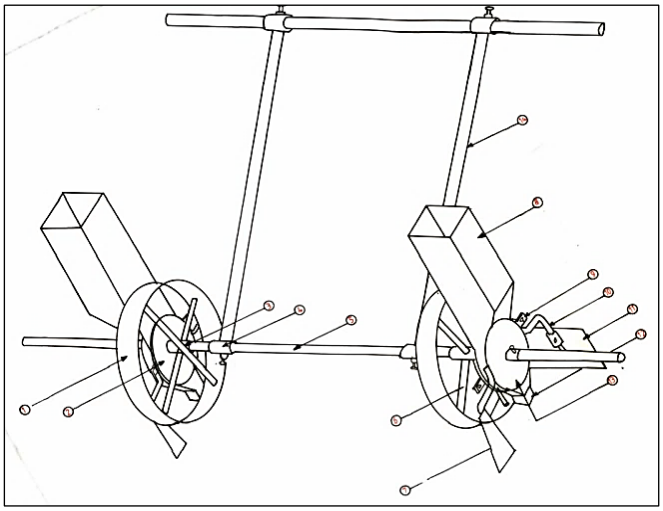


Fig 3: Line diagram of manual Okra Planter

The manual ridge vegetable planter (Fig. 4) consisted of units, namely, seed metering unit, main frame, speed reduction unit, handle, seed tube and tyne. The planter was developed to meter the seed and placement of seed at desired depth and spacing on ridged seedbed. Roller tyres were mounted on two forks. Forks were attached to the main frame. Seed metering mechanism received power from rear roller tyre. Seed tube with conical seed capturing funnel were provided to guide seed to the boot of tyne. Tyne was mounted on tyne bolt for intra-row spacing adjustment.

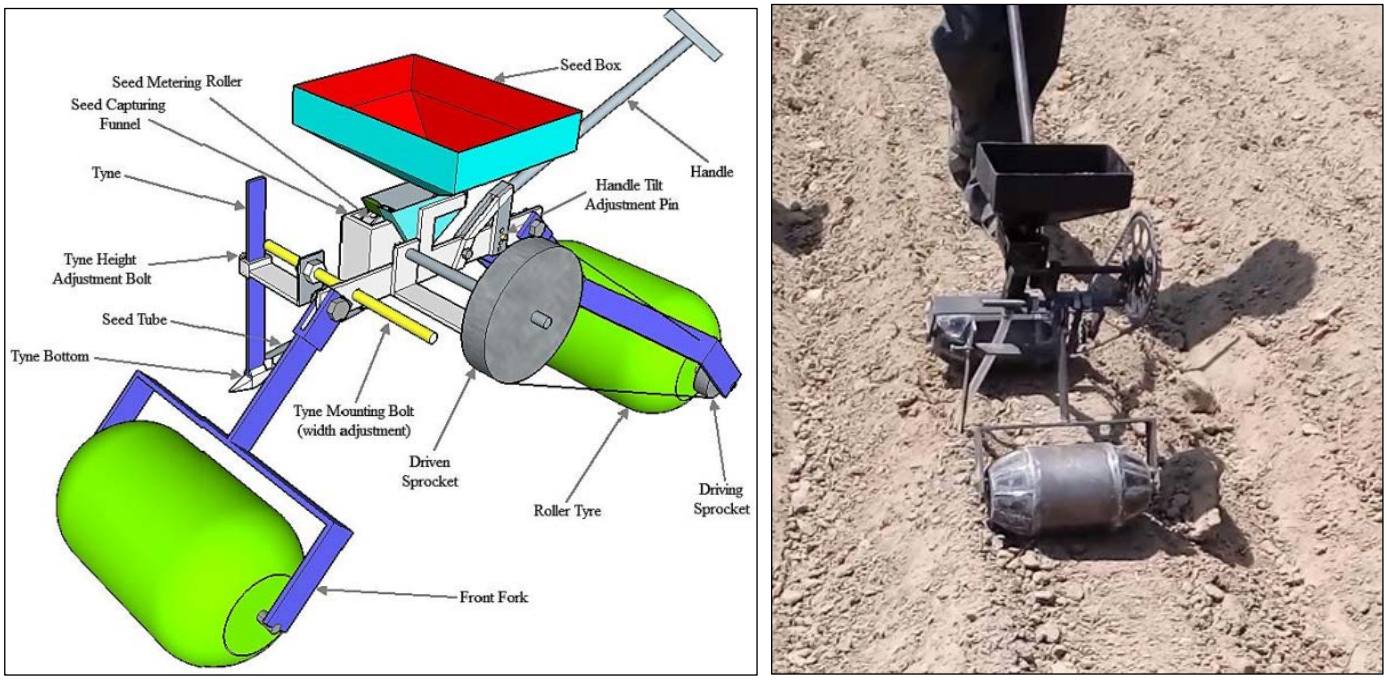
A five-row-tractor-operated inclined plate Okra planter prototype used in the study (Fig.5). It was developed by Badgujar (2020) [5] at the Department of Farm Machinery & Power Engineering, Punjab Agricultural University, Ludhiana. Okra seeds are sown in the well-pulverized field; on both flat and ridges at a15 cm plant spacing, 45 cm row spacing and 3-5 cm depth. Okra is grown in two seasons; spring crop (Feb-Mar) and summer (June-July). *Pusa Sawani*, *Pusa-A4*, *Varsha*, *Uphar* and *Hisar*, *Unna* are improved Okra varieties recommended all over India (Anon., 2015) [2].

3. Results and Discussion

The results of the experiment conducted by the researchers on okra planting are discussed in detail are as follows:

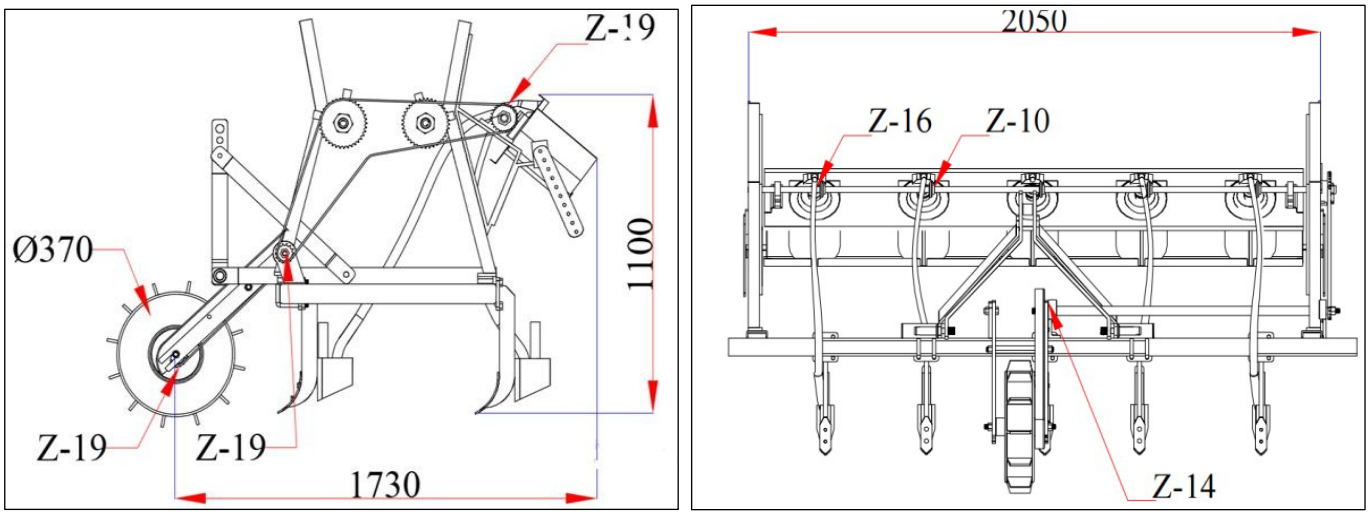
Manually-operated two row okra planters developed from locally available materials to suit the need of the peasant farmers was found to operate at a field capacity of 0.36 ha h^{-1} with an average spacing of 51.75 cm. The planter was able to effectively meter maximum of two seeds per hill with minimum damage to the seeds. The relative ease with which the machine is adjusted and maneuvered in the field suits the technical know- how of the average peasant farmer.

The calculation of the operating costs including fixed and variable costs was made for the developed vegetable planter. The total operating cost of the planter was Rs 70.48 per hour (Rs1409 ha^{-1}). The comparative cost of operation of machine and manual digging is presented in Table 3.



a) Design of the ridge vegetable planter b) Working operation of ridge vegetable planter

Fig 4: Design and development of ridge vegetable planter



Side view Front view

Fig 5: Tractor-operated inclined plate Okra planter

Table 3: Economic evaluation of the planter

SI. No.	Particulars	Planter	Manual planting
1.	Total cost of operation, Rs h^{-1}	70.48	-
2.	Total cost of operation, Rs ha^{-1}		
3.	Man-hours per ha	21.73	44.44
4.	Net saving in cost of operation, Rs ha^{-1}	813	-
5.	Average net annual profit in cost of operation, Rs	3964	-
6.	Annual fixed cost, Rs $year^{-1}$	1488	-
7.	Payback period in year	2.01	-
8.	Benefit cost ratio	1.56	-
9.	Break-even point, h $year^{-1}$	37.53	-

It is evident from the Table 3, that sowing operation by developed planter results into net saving of Rs.813 per hectare. The labour requirements with the developed planter and manual planting were 21.73man-hours per hectare and 44.44 man-hours per hectare, respectively. Thus, it saved 51.1% time of planting in one-hectare area. Dineshkumar reported 31.83% saving in time for single row cotton planter as compared to manual dibbling. The custom hiring fee of operation for developed vegetable planter was calculated as Rs 1416.56 per hour.

The tractor operated prototype planter working width 2.25 m was evaluated at two different locations (X and Y) at Punjab Agricultural University, Ludhiana. It was operated at a speed of 2.17 km h^{-1} and 2.25 km h^{-1}, and an effective field capacity of 0.39 ha/ h^{-1} and 0.41ha $h^{-1}$was observed at locations X and Y, respectively. Fuel consumption and the draft was ranged between 3.2 l h^{-1}to3.4 l h^{-1}and1075.1N to 1125.0 N (Table 4).

Table 4: Results of field evaluation of okra planter

SI. No.	Observations	Location X	Location Y
1.	Forward speed, km h^{-1}	2.17	2.25
2.	Fuel consumption, l h^{-1}	3.2	3.4
3.	Field capacity, ha h^{-1}	0.39	0.41
4.	Draft, kg	109.70 (1075.1 N)	114.80 (1125.0 N)

4. Conclusion

The following conclusions are drawn on the basis on its performance of the different types of okra planters' development and performance evaluation by researches:

- Performance evaluation of manually operated multi crop planter for okra has a field efficiency of 89.83% and field capacity of 0.11 ha h^{-1} with an average planting depth and spacing of 3 cm and 18.76 cm respectively.
- A two-row okra planter developed from locally available materials was able to effectively place maximum of two seeds per hill. It had field capacity of 0.36 ha $hr^{-1}$with average field efficiency of 71.75%.
- The field capacity of the manual ridge vegetable planter was 0.046 ha h^{-1} with field efficiency of 86.79% at a forward travel speed of 1.6 km h^{-1}. Field machine index of planter was 91.68%. The average value of depth of seed placements on ridges was 22.86 mm with coefficient of variation as 3.35%. The total operating cost of the planter was Rs 70.48 per hour (Rs 1409 ha^{-1}). Planting of seeds by the developed planter resulted into net saving of Rs.813 per hectare as compared to manual planting. The payback period and benefit cost ratio of the planter was 2.01 years and 1.56, respectively. The labor requirements with the developed planter were 21.73 man-hours per hectare saving 51.1% time of sowing in one-hectare area as compared to manual dibbling.
- A tractor operated okra planter was studied under laboratory and field conditions for a locally available seed variety. The planter was operated at a speed of 2.17 kmh^{-1} and 2.25 kmh^{-1}, and an effective field capacity of 0.39 ha $h^{-1}$and 0.41 ha $h^{-1}$was observed at locations X and Y, respectively. Fuel consumption and the draft was ranged between3.2l h^{-1} to 3.4 l h^{-1} and 1075.1N to 1125.0 N.
- Among the above findings for proper selection of manually and tractor operated planter sowing for okra seed should be cheap, easily affordable by the rural farmers, easy to maintain and less laborious to use, also to reduce tedious and drudgery, improve timeliness and efficiency of various farm operations, bring more land under cultivation, preserve the quality of agricultural produce, provide better rural living condition and markedly advance the economic growth of the rural sector tractor operated planter also be used.

5. References

1. Anazodo UGN. Agricultural Mechanization as a catalyst for Rural Development. Agricultural Mechanization in Asia, Africa and Latin America (AMA). 1986;17(3):12-18.
2. Anonymous. Package of Practices for Rabi Crops. Punjab Agricultural University, Ludhiana; c2015. p. 38-44.
3. Anonymous. Horticultural statistics at a glance, Horticulture Statistics Division, Government of India; c2017. Available on line: http://www.agricoop.nic.in/
4. Badgujar CM, Dhingra HS, Mannes GS, Khurana R. Development and evaluation of inclined plate metering mechanism for soaked Okra (*Abelmoschus esculentus*) seeds. International Journal of Current Microbiology and Applied Sciences (IJCMAS). 2017;6(12):3948-3961.
5. Badgujar CM, Dhingra HS, Gautam A, Khurana R, Mannes GS. Experimental study on okra planter for sowing of soaked seed, Agricultural Engineering Today. 2020;44(4):22-29.
6. Bamgboye, Mofolasayo A. Performance Evaluation of a Two-Row Okra Planter. Agricultural Engineering International: the CIGR E journal. Manuscript PM 06 002, 2006, 8.
7. Bamiro OA, Nurudeen A, Akuru IO. Introductory Technology for schools and colleges. Evans Brothers (*Nigeria publishers*) limited; c1986. p. 227-233.
8. Dineshkumar R, Jaimin P. Performance evaluation of manually operated single row cotton planter. International Journal of Engineering Sciences & Research Technology. 2014;3(9):40-44.
9. Gupta CP, Totok Herwanto. Design and development of a direct paddy seeder. Agricultural Mechanization in Asia, Africa and Latin America. 1992;23(1):23-27.
10. Kalay Khan, Moses SC. Performance Evaluation of Manually Operated Multi-Crop Planter for Okra, Journal of Pharmacognosy and Phytochemistry; c1017. p. 264-269.
11. Khambalkar VP, Karale DS, Kankal US. Evaluation of self-propelled pneumatic planter for rain-fed crops. International Journal of Agricultural Engineering. 2014;7(1):225-228.
12. Kumar K, Naresh NK, Ojha TP. Design, construction and performance of a manually-operated seeding attachment for an animal drawn cultivator. Agricultural Mechanization in Asia, Africa and Latin America. 1986;17(2):35-38.
13. Ladehinde MA, Verma SR. Performance evaluation of hand-operated seed planters in light and medium soils in Nigeria. Agricultural Mechanization in Asia, Africa and Latin America. 1994;27(3):17-19.
14. Molin JP, D'Agostini V. Development of a rolling punch planter for Stony soil conditions. Agricultural Mechanization in Asia, Africa and Latin America. 1996;27(3):17-19.
15. Sahoo PK, Srivastava AP. Development and performance evaluation of okra planter. Journal of Agricultural Engineering. 2000;37(2):15-25.