Review on Seed Sowing Methods for Improved Agricultural Productivity

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ABSTRACT: **In this paper, the effect of farm mechanization technique on agriculture in India is studied. The paper discusses the use of different types of seeder technology in reducing the sowing time, improvement in crop quality along with decreasing the negative impact on environment. Thus, it is found that modern-day seeder technologies are promoting sustainable growth in agriculture in India. The paper also mentions various types of crop seasons in India. The methods of seed sowing are also described briefly. Finally, it is highlighted that the main aim to implement any farm mechanization technique is to develop low-cost farm machinery that can reduce the production cost of agriculture by 18%, increase the incomes of the farmers by 12.6% and reduce environmental degradation by 37.2%.**

Keywords: Farm machinery, mechanization, agriculture, sustainable, sowing, seeder

1. INTRODUCTION

India is a developing country where a major part of the population is absorbed in agricultural sector. To cater to the increasing demand of food due to population growth it is necessary to increase the agricultural production by adopting advanced farm machineries, and better crop management practices [1]. The challenge lies in low income of the farmers due to which outdated farming techniques are used till date. By developing farm equipment at low cost [2] their affordability can be increased. This in turn will help increase the agricultural produce and income of the farmers simultaneously.

The use of mechanization in agricultural sector will help increase the produce [3] up to a certain extent only. There are other factors called the environmental factors [4] that also play a major role in deciding the agricultural produce. Due to global warming, climate has changed drastically over the last few years. Rise in pollution has led to air, water, and soil degradation. There is a pressing need for environmental-friendly sustainable growth [5] where technological advancement is conducive to environment as well.

1.1 Crops in India

Based on climatic conditions, two main types of crops are found in India. These are Rabi crops and Kharif crops. Rabi crops are sown mainly in mid-November after the monsoon season is over and are harvested in April or May. They require low temperatures to grow. The temperature should be between 10°C and 20°C with a rainfall between 50 cm and 90 cm. Examples of Rabi crops are barley, peas, gram, mustard, tomato, beet, alfalfa, cabbage, sunflower, fennel, onion, cumin, coriander, oat, potato, etc. Their cultivation is done mainly in Punjab, Haryana, Himachal Pradesh, Jammu & Kashmir, Uttarakhand, and Uttar Pradesh.

On the other hand, Kharif crops are sown in June and harvested in October. These crops require hot and humid climatic conditions, plenty of sunshine, and rainfall. Examples of Kharif crops are rice, maize, jowar, millet, arhar, soyabean, cotton, moong, sugarcane, brinjal, turmeric, etc. Their cultivation is done mainly in Assam, West Bengal, Andhra Pradesh, Telangana, Konkan, Uttar Pradesh, and Bihar.

2. SEED SOWING

Sowing is an art of placing seeds in the soil to have good germination in the field. A perfect sowing is advantageous as it ensures the following.

(i) Correct number of seed per unit area
(ii) Correct depth of sowing

(iii) Correct spacing between any two seeds, both row-wise and plant-wise
(iv) Correct seed rate.

2.1 Sowing methods

There are different types of seed sowing methods [6], [7]. These are as follows.

a) Broadcasting: It is a method of random scattering of seeds on the surface of seedbed. It can be done either manually or mechanically. Uniformity of seed scattering depends upon the skill of the farmer. Soon after broadcasting, the seeds are covered through a plank. Higher seed rate is obtained in this system.
b) Dibbling: It is the process of placing seeds in holes made in the seedbed at a definite depth and at fixed spacing. A conical shaped instrument known as dibbler is used for dibbling. It is a very time-consuming process and hence unsuitable for sowing small seeds.
c) Drilling: In this process, the seeds are dropped in furrows in a continuous stream and then covered with soil. This can be done by using seeders drawn by either tractors or by domestic animals. This method achieves proper depth of sowing but seed spacing is not uniform.
d) Seed dropping behind the plough: It is a common method of seed sowing followed by the farmers in the villages. Seed is dropped through a bamboo stick having a funnel shaped mouth. It involves two farmers. The one ploughs the field and the other one drops the seeds through the bamboo funnel. The process is very slow and laborious.
e) Transplanting: Transplanting involves raising the seedlings in a nursery and then planting the seedlings in another field called the main field. It is commonly done for paddy, vegetables, and flowers. It is a time-consuming operation. Transplanter can be used for planting the seedlings in the main field.
f) Hill dropping: In this method, few seeds are dropped as a hill at a fixed place. The spacing between two consecutive hills within a row is kept constant.
g) Check-row planting: In this method of seed sowing, row-to-row and plant-to-plant distances are uniformly maintained. The seeds are planted precisely along straight parallel furrows.
h) The new methods of ‘LASER levelling’ and ‘ridge sowing’ [8] offer a great potential in cost reduction in agricultural production with simultaneous reduction in environmental degradation.

2.2 Mechanized farm equipment

The mechanized farm equipment includes agriculture seeders and planters for automatic sowing [9] of seeds. There are various types of agricultural seeders offering a variety of features. Few of them are mentioned here.

a) Seed-cum-fertilizer drill: It consists of seed box, fertilizer box, seed and fertilizer metering mechanism, seed tubes, furrow openers [10], seed and fertilizer rate adjusting lever and power transmission system. The equipment provides a facility of altering the depth of the grooves exposed to the seed. The number of seeds sown can be varied according to the type of seed used during sowing. The seed-cum-fertilizer drills are used for sowing seeds of cereal crops in the fields which are prepared already.
b) Strip-till drill: It consists of a standard seed drill with a rotary attachment in the front. The rotary system contains C-type blades which prepares a 75 mm wide strip in front of every furrow opener. With every row in the field used for sowing seed, 125 mm strip is left untilled. By using strip-till drill machine, tilling and sowing can be done simultaneously. The advantage of strip-till drill is that it can be used for sowing seeds without any prior seed-bed preparation. The machine is 50-60 % more fuel efficient than conventional sowing methods and saves 65-75% of sowing time.
c) Zero-till drill: It is used for sowing seeds without prior tillage or ploughing. The machine is designed in such a way that it drills seeds directly into the untilled soil or previous crop residue. It also consists of seed box, fertilizer box, seed and fertilizer metering mechanism, seed tubes, furrow opener, and power transmission system. Zero-till drill machines are crucial to modern

agriculture. They promote sustainable farming practices along with improving productivity and profitability.

2.3 Components of agricultural seeder

The various components [11] of an agricultural seeder are described below.

a) Frame: The frame is made up of mild steel angles welded together. It provides the desired strength and rigidity. For a zero-till drill having nine tines, the typical dimensions of the frame are 185 cm x 60 cm. For eleven tines, the length is increased to 220 cm. The height of the frame varies between 110 cm and 145 cm. Weight can be between 250 kg to 350 kg. A 35 hp tractor can easily draw this weight.
b) Slit or furrow openers: Furrow openers are attached to the tines. They open a narrow slit into the field. The narrow slit is usually 3 cm to 5 cm wide. The spacing between any two slit/ furrow openers in case of a zero-till drill machine is usually 17.5 cm. The slits are 8 mm thick. To increase or decrease the depth of furrows, depth control wheels are provided.
c) Seed and fertilizer box: Seed and fertilizer boxes are mounted adjacent to each other on the frame. They are trapezoidal in shape and made up of mild steel or galvanized iron sheet having 2 mm thickness. The dimensions of the seed and fertilizer boxes vary according to the effective width of the seeder and the number of furrow openers required. For a 11-tine drill, the length of the seed and fertilizer boxes may be around 178 cm.
d) Seed metering device: It is used for precise planting of seeds in the fields. It ensures distribution of seeds at a consistent rate and uniform spacing in the field to optimize crop growth. The various types of seed metering device include air-based systems, mechanical systems, and vacuum-based systems. The selection of seed metering device depends upon the type of crop, planting conditions, and desired planting accuracy.
e) Fertilizer metering device: A fertilizer metering device accurately measures and distributes the right amount of fertilizer to the crops. The various types of fertilizer metering devices are gravity-fed hoppers, auger-based systems, etc. depending upon specific applications and the machine.
f) Power transmission unit: It consists of a power source that transfers power from the source to various components of the seeder including the seeding mechanism, and the depth control system. It consists of drive wheel, shaft, idler, sprocket, and roller chain.
g) Hitch points: There are three standard hitch points- two lower and one upper. The machine is connected to tractor through these hitch points with the help of link pins. The top hitch point is also used for levelling the machine.
h) Iron/ wooden platform or stand: It is attached to the rear side of the frame. Its main purpose is to allow a person to stand on it for manual inspection of the whole seeding process. It is a precautionary measure.

While using a seeder, it is necessary to calibrate it. The laboratory testing of a seeder to determine the rate of delivery of seed is called as the calibration [12] of the seeder. This is performed to ascertain whether the seeder is delivering the seeds as per the recommended seed rate or not. Calibration avoids the difficulty of setting the seed delivery rate of the seeder in actual field conditions.

3. AGRICULTURE IN PUNJAB- A CASE STUDY

The state of Punjab has a land area which is 1.5% of the total land area of India. But it produces 20% of country's wheat and 12% of country's rice. Punjab alone contributes 60% of wheat and 40% of rice to central food grain reserves in India. Cultivation of wheat and rice and other crops produces heavy amount of straw also. The farmers burn these straws to clear the fields. The burning of these straws causes great amount of air pollution and also makes the field deficient in nutrients. Replenishment of these nutrients require the use of chemical fertilizers which increase the cost of agricultural production and also cause soil and water pollution. In order to overcome these problems, the department of Farm Power and Machinery at Punjab Agricultural University, Ludhiana developed an in situ Happy Seeder

technology in collaboration with CSIRO Land and Water, Australia under the financial assistance from ACIAR. The Happy Seeder machine combines the benefits of seed sowing and straw management simultaneously. It is found that by using this novel technology, farmers can save up to 5.38 hours of time, 16.03 litres of fuel, and Rs. 3250 per hectare over the conventional practice of sowing wheat. Table 1 compares between the costs of wheat sowing incurred for cultivation methods using happy seeder technology and conventional practices.

TABLE 1: Comparison of operational costs incurred on methods using happy seeder technology and conventional approach during sowing of wheat [13]

S. No.	Parameters	Cost incurred (Rs. / hectare)	
1.	Management of loose straw	750	750
2.	Field preparation	Nil	4500
3.	Sowing	3750	3000
4.	Seed + treatment	3900	3150
5.	Weedicide	2275	3875
6.	Fertilizer	5625	5625
7.	Irrigation	750	1125
8.	Insect-pest management	1962.5	1812.5
9.	Harvesting	3000	3000
Total cost incurred		22013	26838
Gross return (crop yield + straw yield)		99384	95546
Net return		77371	68708
Benefit-Cost (B.C.) ratio		4.5	3.6

From Table 1 it can be found that the total cost of wheat sowing while using the happy seeder technology is 18% lower than the conventional methods of wheat sowing. The net return also increases by 12.6%. The higher benefit-cost ratio achieved by using the happy seeder technology than the conventional method in wheat sowing makes it an economically viable and sustainable practice of farming. Table 2 compares between the various crop parameters obtained by using the happy seeder technology and the conventional method of wheat sowing. From the table, it can be found that there is a significant improvement [14] in various crop parameters by using the happy seeder technology against the conventional method of farming. Both the grain quality and grain yield increased by using the happy seeder technology. This is because the grains took slightly more time to mature. The water requirement also decreased by 37.2% (accounting for less environment degradation by reducing dependency on diesel-run tube wells) along with 58.2% less growth of weeds. Thus, by using this novel technology, the farmers and environment become really happy.

TABLE 2: Comparison of crop parameters obtained by using happy seeder technology and conventional method of wheat sowing [13]

S. No.	Parameters	Methods of wheat sowing	
		Happy seeder	Conventional
1.	Weed count per sq. metre	22.9	54.8
2.	Water requirement (mm)	175.8	280
3.	Percentage lodging	5-7	15-25
4.	Days to maturity	165	155
5.	Grain quality (weight of 1000 grains)	45	41

6.	Grain yield (quintal/ hectare)	49.3	47.3
7.	Straw yield (quintal/ hectare)	31.02	28.38

4. CONCLUSIONS

This paper provides a brief information of various crop seasons in India, and sowing methods. The paper describes the components of a mechanical seeder. With the help of a case study it is shown that by using advanced farm equipment, agricultural production can be increased with less harm to environment. Various types of seeders available are also described. Use of such equipment promote cost reduction, in situ management of agricultural produce, less weeds, and compatibility with the environment. However, the long-term impact of using mechanized farm equipment on soil property, flora and fauna, and economic lives of farmers need to be explored.

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