

# Effectiveness of Rotavator towards Cleaner Environment and Enhanced Agricultural Productivity

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## Abstract

**Objectives:** To check the effect of various methods used for seedbed preparation namely manually prepared seedbed and seedbed prepared by using rotavator, also for the use of organic fertilizer and chemical fertilizers on Pigeon Pea crop production. **Method/Approach:** In this experiment the entire 9 acre land is divided into 18 equal plots. The combination of seedbed preparation and fertilizers are finalised in 9 different categories. Two plots were selected randomly for each combination of seedbed preparation and fertilizer for the experiment, and the final product is combined to measure the total output and to compare which is the best combination. The chemical fertilizer used is divided into three categories according to their proportion one is as per the guidelines of Ministry of Agriculture, central government, India; *i.e.* 50kg per acre, other quantity is much lesser than the guidelines *i.e.* 35kg per acre and last one is according to actual farmers practice in the region *i.e.* 65kg per acre. The quantity of organic fertilizer used is 45kg per acre and 60kg per acre for both seedbed preparations were done by manually and by using rotavator. **Findings/Observations:** The maximum production of Pigeon Pea of 814kg was obtained from plot whose seedbed is prepared by using rotavator and organic fertilizer followed by 802 kg from the plot whose seedbed is prepared by using rotavator and chemical fertilizer was used. The minimum Pigeon Pea production of 690kg was obtained from the plot whose seedbed was prepared manually and chemical fertilizer was used. **Applications/ Improvements:** Use of rotavator for seedbed preparation for sowing and organic fertilizers can be used for every conventional as well as cash crop. Seedbed preparation by using rotavator gives better pulverisation which affects in higher crops productivity also organic fertilizers eliminates the chances of soil and water pollution which results in achieving higher benefit to cost ratio for farmers.

**Keywords:** Chemical Fertilizer, Organic Fertilizer, Productivity, Rotavator, Soil and Water Pollution

## 1. Introduction

In recent years, the use of chemical fertilizers in agricultural land increased exponentially everywhere the world, which results in serious environmental problems. Excessive use of fertilizers (chemical fertilizers) in agricultural land for better crop rate, leads to large number of environmental problems. Presence of heavy metals in the chemical fertilizers leads to soil and water pollution<sup>1</sup>. An excessive use of nitrogen in the agricultural land is not taken up by the plant and ends up in the soil, from where it goes to the water bodies (river, coastal

areas, lakes and groundwater) and to atmosphere where it contaminates drinking water and the environment<sup>2</sup>. Maintenance of soil fertility is a prerequisite for long-term sustainable agriculture where use of rotavator for seedbed preparation, organic fertilizers and manure (Cow dung, Poultry manure and Mustard oil cake) can play a major role in the crop production and maintaining soil fertility<sup>3</sup>. Presence of earthworms in the agricultural land shows the greater fraction of biomass of invertebrate in the agricultural soil as soil macro fauna; and play a vital role in soil structuring and enhancing plant nutrients and hence they can be successfully used as bio indicators for the

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evaluation of toxic risks of xenobiotic in the agricultural land<sup>4</sup>. It is widely believed that organic fertilizers helps to improve and maintain earthworm populations by providing highly nutrient rich substrate for earthworm populations, independent of whether they feed upon the microorganisms which colonize the organic materials or they feed directly upon the organic matter. Indian farmers overuse chemical fertilizers to achieve higher productivity ignoring its negative effects on the agricultural land<sup>5</sup>.

Phosphate and nitrate pollution has been reported as one of the main problem in agriculture and terrestrial ecosystems, especially under intensive use of chemical fertilizers containing phosphorous and nitrogen<sup>6</sup>. Leaching of Phosphate and nitrate is the most prevalent groundwater pollutant and it also represents a serious health problem. Several researchers and scientists have studied mineral levels in different bodies of water sources, and have concluded that, the levels of nitrates and phosphates have major impact on the overall purity of the water<sup>7</sup>. A recent Greenpeace Research Laboratories investigation on the effects of synthetic nitrogen fertiliser on groundwater pollution in intensive agriculture areas in three districts of Punjab shows that 20 per cent of all sampled wells have nitrate levels above the safety limit of 50 mg of - nitrate per litre (50mg/L NO<sub>3</sub> for drinking water established by the World Health Organisation (WHO)<sup>8</sup>. Under soil fertility management it has been suggested that combinational use of organic manures with fertilizers will not only sustain the agricultural soil health but also increases crop production rate effective in enhancing the nutrient use efficiency of agricultural soil<sup>9</sup>. The same is shown in Figure1.



**Figure 1.** Land prepared by using Rotavator.

This experiment was conducted in the village of Jalgaon district of Maharashtra state of India. Total 9 acre of agricultural land in the village of two farmers was used for this experiment. The experiment was conducted for

Pigeon Pea crops for small periods of time of 200 days from June 2016 to December 2016<sup>10</sup>. The objective of this experiment is to analyse the effect of combination of method of seedbed preparation and fertiliser used on productivity of crops. The use of organic fertilizers also nullifies the chances of soil and water pollution<sup>11</sup>.

## 2. Objectives

The objective of this study is to check the effect of various methods used for seedbed preparation namely manually prepared seedbed and seedbed prepared by using rotavator, also for the use of organic fertilizer and chemical fertilizers on Pigeon Pea crop production.

## 3. Materials and Methods

For this experiment the entire 9 acre land is divided into 18 equal plots. The combination of seedbed preparation and fertilizer used are finalised in 9 different categories which is Table 2 Two plots were selected randomly for each combination of seedbed preparation and fertilizer for the experiment, and the final product is combined to measure the total output and to compare which is the best combination.

The general recommendation for use of chemical fertilizer is 50kg/acre in agricultural lands as per the Indian soil testing manual released in 2011 by the Central Ministry of Agriculture, Central Government, India. The chemical fertilizer used in the experiment was Urea available in the local market. When urea is applied to the soil, it is converted to ammonia, chemical reaction takes place with water to form ammonium ions within short time period of 2 to 3 days (faster under warm conditions). Naturally occurring organic substance consisting primarily of minor levels of minerals, gypsum, humic acid and clays. It eases organic material incorporation to the soil, it also accelerating its nutrient utilization and decomposes at faster rate<sup>12</sup>.

The seedbed preparation of 10 plots was done by manually and of 8 plots was done by using rotavator. The chemical fertilizer was used in 9 plots and organic fertiliser was used in 9 plots. The amount of urea (chemical fertilizer) used is divided into three categories one is as per the guidelines of Ministry of Agriculture, Central Government, India; *i.e.* 50kg per acre, other

quantity is much lesser than the guidelines *i.e.* 35kg per acre and last one is according to actual farmers practice in the region *i.e.* 65kg per acre. The quantity of organic fertilizer used is 45kg per acre and 60kg per acre for both seedbed preparations were done by manually and by using rotavator. The mode of selection of plots for this experiment for the combination of fertilizer used and type of seedbed preparation is shown in Table 1.

**Table 1.** Randomly Plots selection for experiment

|         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|
| M1U1-35 | M1O1-45 | M2O2-45 | R1U1-65 | R2U2-65 | R2U2-45 |
| R2O2-60 | M1O1-60 | R1O1-60 | M2U2-35 | R1O1-60 | M2U2-50 |
| M1U1-65 | R2O2-60 | M1U1-50 | R1O1-45 | M2O2-60 | M2U2-65 |

### 3.1 Working Depth

Working depth of the rotavator can be defined as the total depth obtained for pulverisation in single pass of Rotavator. It should be as higher as possible.

### 3.2 Tractor Power Requirement

Tractor power requirement can be stated as the capacity or power (HP) of tractor required to carry the Rotavator effectively for performing effective tillage operation. It should be as minimum as possible.

### 3.3 Cultivation Capacity

Cultivation capacity of a Rotavator can be defined as the area (in Acre) covered in tillage operation for seed bed preparation by a Rotavator in per unit time (Hour). The cultivation capacity of a Rotavator can be measured in Acre per Hour. The heavy weight of Rotavator may result in the lifting upward of the tractor from front side and hence proper weight balancing is required which minimises vibration which results in higher Cultivation Capacity (Acre per Hour). The same is shown in Table 2.

## 4. Results and Discussions

Urea (chemical fertilizer) was found to be quite toxic to the health of Pigeon Pea plants and earthworm present in the soil. There was a significant correlation between the concentration of Urea added to soil and the productivity of crops. The quantity and quality of Pigeon Pea crops decreased steadily with the increase in the dose of Urea.

Healthy plants and higher crop productivity of Pigeon Pea in the plots prepared by using rotavator and used of organic fertilizer set up can be attributed to the fact that the organic fertilizers probably provide effective nutrition directly for the crops and this might be the reason for the higher productivity. The same is shown in Figure 2.

**Table 2.** Method of seedbed preparation and fertilizer used

| Sr. No. | Notation | Description  |
|---------|----------|--|
| 1       | M1U1-35  | Plot 1, manual seedbed preparation with use of Urea 35kg/acre                  |
| 2       | M2U2-35  | Plot 2, manual seedbed preparation with use of Urea 35kg/acre                  |
| 3       | M1U1-50  | Plot 1, manual seedbed preparation with use of Urea 50kg/acre                  |
| 4       | M2U2-50  | Plot 2, manual seedbed preparation with use of Urea 50kg/acre                  |
| 5       | M1U1-65  | Plot 1, manual seedbed preparation with use of Urea 60kg/acre                  |
| 6       | M2U2-65  | Plot 2, manual seedbed preparation with use of Urea 65kg/acre                  |
| 7       | M1O1-45  | Plot 1, manual seedbed preparation with use of organic fertilizer 45kg/acre    |
| 8       | M2O2-45  | Plot 2, manual seedbed preparation with use of organic fertilizer 45kg/acre    |
| 9       | M1O1-60  | Plot 1, manual seedbed preparation with use of organic fertilizer 60kg/acre    |
| 10      | M2O2-60  | Plot 2, manual seedbed preparation with use of organic fertilizer 60kg/acre    |
| 11      | R1U1-50  | Plot 1, Rotavator seedbed preparation with use of Urea 50kg/acre               |
| 12      | R2U2-50  | Plot 2, Rotavator seedbed preparation with use of Urea 50kg/acre               |
| 13      | R1U1-65  | Plot 1, Rotavator seedbed preparation with use of Urea 65kg/acre               |
| 14      | R2U2-65  | Plot 2, Rotavator seedbed preparation with use of Urea 65kg/acre               |
| 15      | R1O1-45  | Plot 1, Rotavator seedbed preparation with use of organic fertilizer 45kg/acre |
| 16      | R2O2-45  | Plot 2, Rotavator seedbed preparation with use of organic fertilizer 45kg/acre |
| 17      | R1O1-60  | Plot 1, Rotavator seedbed preparation with use of organic fertilizer 60kg/acre |
| 18      | R2O2-60  | Plot 2, Rotavator seedbed preparation with use of organic fertilizer 60kg/acre |

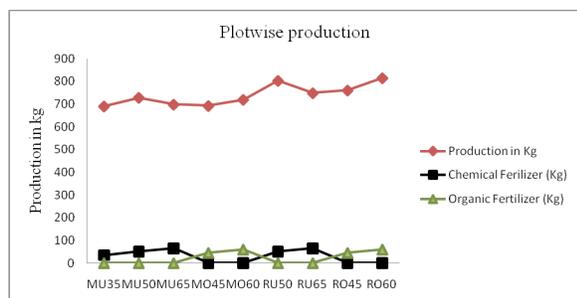


Figure 2. Plot wise Pigeon Pea production.

Plot wise total Pigeon Pea production output of seedbed prepared manually and by using rotavator also for use of chemical and organic fertilizer is shown in Table 3. Use of organic fertilizer instate of chemical fertilizer which not only improve Pigeon Pea production rate but also help in minimizing the enrichment of ground water, river water and lake water also reduces soil pollution caused by excessive use of chemical fertilizer.

Table 2. Plot wise Pigeon Pea production

| Sr. No. | Notation | Plot wise Production | Total Output |
|---------|----------|----------------------|--------------|
| 1       | M1U1-35  | 341kg                | 690kg        |
| 2       | M2U2-35  | 349kg                |              |
| 3       | M1U1-50  | 365kg                | 728kg        |
| 4       | M2U2-50  | 363kg                |              |
| 5       | M1U1-65  | 348kg                | 698kg        |
| 6       | M2U2-65  | 350kg                |              |
| 7       | M1O1-45  | 346kg                | 692kg        |
| 8       | M2O2-45  | 346kg                |              |
| 9       | M1O1-60  | 360kg                | 719kg        |
| 10      | M2O2-60  | 319kg                |              |
| 11      | R1U1-50  | 400kg                | 802kg        |
| 12      | R2U2-50  | 402kg                |              |
| 13      | R1U1-65  | 374kg                | 748kg        |
| 14      | R2U2-65  | 374kg                |              |
| 15      | R1O1-45  | 379kg                | 760kg        |
| 16      | R2O2-45  | 381kg                |              |
| 17      | R1O1-60  | 411kg                | 814kg        |
| 18      | R2O2-60  | 403kg                |              |

## 5. Conclusions

The maximum production of Pigeon Pea of 814kg was obtained from plot whose seedbed is prepared by using rotavator and organic fertilizer followed by 802kg from the plot whose seedbed is prepared by using rotavator and chemical fertilizer was used. The minimum Pigeon Pea production of 690kg was obtained from the plot whose seedbed was prepared manually and chemical fertilizer

was used.

From above experiment, we can say that the combination of rotavator for seedbed preparation for sowing and organic fertilizer can be adopted for higher crop production and higher benefit to cost ratio. It also nullifies the chances of soil and water pollution which results in cleaner and healthy environment.

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