

Optimizing Rotavator Design Towards Enhancing Agricultural Crop Productivity



Ankush D. Bhishnurkar, Ashok G. Matani

Abstract: By continuous and rapid growth in industrialization as well as population, the agricultural lands are also becoming less and less continuously day by day which results in increase in the population of small land holders. In addition to this, because of continuous decreasing production the youth of the villages are also migrating in big cities for the employment, resulting decreasing manpower essential to perform various seedbed operations in the villages. Hence, it is the need of time for small farmers having small agricultural land and having less crop production to introduce the cost-effective farm mechanization so that they can improve production rate. Rotavator is the best option available to achieve this landmark as it is already proved that seedbed prepared by using rotavator gives highest benefit to cost ratio. For this experimental study the whole land of 9 acre area is divided into 18 plots of equal size in area. The combination of method of seedbed preparation and use of fertilizers were the preliminary criteria. The categories of fertilizer according to quantity are discussed earlier which are 50kg, 35kg and 65kg per acre respectively. The quantities of organic fertilizer used are 45kg and 60kg per acre of agricultural land for both seedbeds which are prepared manually and by using rotavator. The highest production of Pigeon Pea was obtained of 814kg was from the plot whose seedbed is prepared by using agricultural machine called rotavator and organic fertilizer; next highest production is obtained of 802 kg from the plot whose seedbed is prepared by using rotavator and the fertilizer used was chemical fertilizer. The minimum production of Pigeon Pea which is 690 kg was obtained in the plot whose seedbed was prepared manually and chemical fertilizer was used.

Index Terms: Fertilizer, Plot, Production, Rotavator, Seedbed Preparation

I. INTRODUCTION

Rotavator can play an important role in double or multiple cropping systems where the time for land preparation is very less or limited. Rotavator is a tillage implement comprising of various types of blades like L-shaped, C-shaped and J-shaped mounted on flanges, L-shaped blades are preferred over C-shaped and J-shaped blades. This implement affixed to a shaft that is driven by tractor Power-Take-Off (PTO) [1]. It is used for mixing manure or fertilizers into soil and for seedbed

preparation. It offers an advantage of superior soil mixing, better pulverisation. It also saves time and money to prepare seedbed rapidly for multi season farmers [2].

Rotavator is the best option available to achieve this landmark as it is already proved that seedbed prepared by using rotavator gives highest benefit to cost ratio. It is also proved that use of rotavator for seedbed preparation also saves time and money compared to other method such as use of cultivator or manually seedbed preparation done [3]. In this experimental study the whole land of 9 acre area is divided into 18 plots of equal size in area. The combination of method of seedbed preparation and use of fertilizers were the preliminary criteria for finalising the lots for study. Based on these parameters all 18 plots were divided in 9 different categories. Out of 18 plots two plots were selected randomly for each combination of method of seedbed preparation and use of type of fertilizer for the experimental study. The best combination of method of seedbed preparation and use of type of fertilizer is opted from the final combined production of two similar plots of 9 categories finalised earlier. The use of chemical fertilizer is divided into three sections according to the quantity of fertilizer used in agricultural land. First category is as per the guidelines of the Agriculture Ministry, Government of India; i.e. farmer should not use more than 50kg of chemical fertilizer per acre of land, second category is use of 35kg of chemical fertilizer per acre of land, and the final category for study is according to actual practice what farmers are using in the region i.e. 65kg of chemical fertilizer per acre of land. On the other hand the quantity of organic fertilizer selected for study is in two categories one is 45kg per acre and other is 60kg of chemical fertilizer per acre of land for both seedbed preparations were done by manually and by using rotavator [4].

II. MATERIAL AND METHODS

For this experimental study the whole land of 9 acre area is divided into 18 plots of equal size in area. The combination of method of seedbed preparation and use of fertilizers were the preliminary criteria for finalising the lots for study which is shown in Table 2. The selections of plots were done randomly. Plots were selected in the group of two randomly for the every combination of seedbed preparation and use of fertilizer for this experimental study, and the final production of two plot of same category is combined to measure the total output and to compare and find which is the best combination of method of seedbed preparation and fertilizer used.

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The general guidelines for use of chemical fertilizer from Agricultural Ministry is 50kg/acre in agricultural lands as per the Indian soil testing manual released in 2011 by the Central Agriculture Ministry, GoI [5]. Urea is used as chemical fertilizer in this experiment available in the local market. When urea reacts with the soil, it gives the product called as ammonia; within the short time span 2 to 3 days (faster under warm conditions) ammonium ions gets formed by chemical reaction that takes place with water.

Naturally available organic substance mainly consists of basically minor levels of minerals, clays, gypsum and mainly humic acid [6]. It eases organic material incorporation to the soil, it decomposes at faster rate by accelerating its nutrient

utilization. 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 fertilizer was used in 9 plots. The amount of urea used is divided into three categories. The categories of fertilizer according to quantity are discussed earlier which are 50kg, 35kg and 65kg per acre respectively [7]. The quantities of organic fertilizer used are 45kg and 60kg per acre of agricultural land for both seedbeds which are prepared manually and by using rotavator. The method 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

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

III. MATERIAL AND METHODS

Urea which is used as chemical fertilizer was found quite toxic to the health of Pigeon Pea plants and earthworm present in the soil. There was a significant correlation between the amount of Urea used and the productivity of crops in the agricultural land [8]. 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 where organic fertilizer were used and prepared by using rotavator have provided better productivity because

organic fertilizers probably provide effective nutrition directly to the crops and this might be the reason for the higher productivity. 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 3. 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	

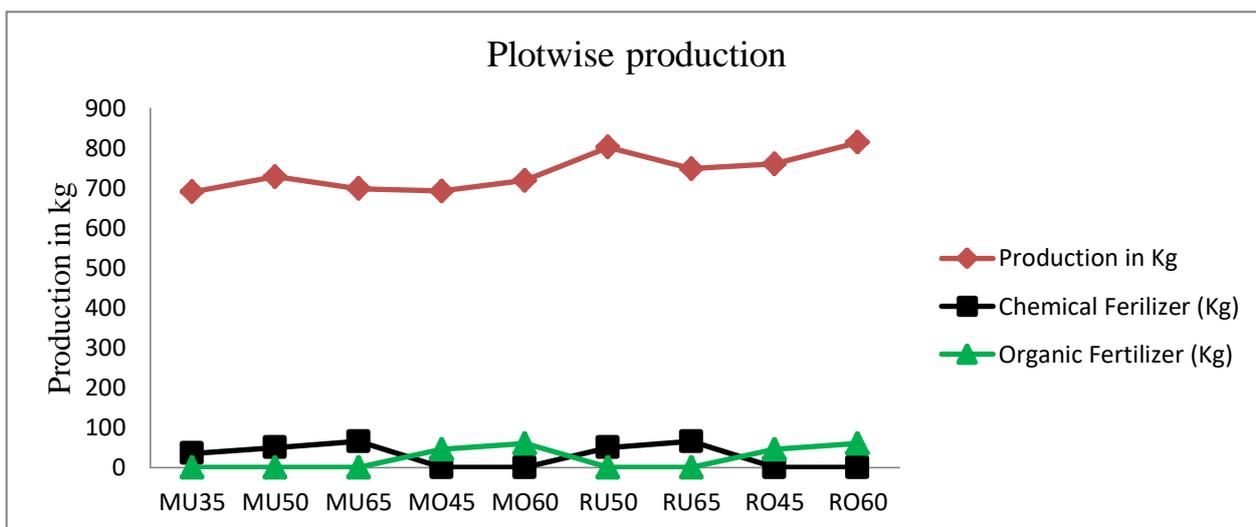


Figure 1. Plot wise Pigeon Pea production

IV. CONCLUSIONS

Experimental study of the whole land of 9 acre area which is divided into 18 plots of equal size in area was done. The combination of method of seedbed preparation and use of fertilizers were the preliminary criteria during the experimentation. The highest production of Pigeon Pea obtained was 814kg from the plot whose seedbed was prepared using agricultural machine called rotavator and organic fertilizer. Next highest production obtained was about 802 kg from the plot whose seedbed was prepared using rotavator and the fertilizer used was chemical fertilizer. The minimum production of Pigeon Pea of 690 kg was obtained in the plot whose seedbed was prepared manually with the use of chemical fertilizer. Hence the risk of soil and water pollution is minimised by using organic fertilizers. Also the effects of harmful chemical sprays will be eliminated by use of organic fertilizers. From above experimental study we can conclude that the category having combination of both organic fertilizer as well as rotavator for seedbed preparation for sowing should be adopted for higher crop production and higher benefit to cost ratio.

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[1] National Productivity Competition 2015The Case Study Competition, 3rd International Conference on Industrial Engg(ICIE-2015)@SVNIT Surat, 26-28th Nov 2015.

[2] Sixth Annual Research Symposium in Chemical Engg, ChEmference 2015, Indian Institute of Technology(IIT), Hyderabad, 5-6th Dec. 2015

[3] International Conference on Contemporary Design & Analysis of Manufacturing and Industrial Engineering Systems, NIT Tiruchirapalli [TN] 18-20th Jan.2018.