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**Optimizing Effective rotavator design towards enhancing agricultural crop productivity and minimizing water consumption**

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Abstract

Rotavator can play an important role in double or multiple cropping systems where the time for land preparation is very less or limited.It is used for mixing manure or fertilizers into soil and for seedbed preparation. It offers an advantage of superior soil mixing, better pulverisation, rapid seedbed preparation and reduced draft compared to conventional tillage.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. 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 690 kg was obtained from the plot whose seedbed was prepared manually and chemical fertilizer was used.

***Keywords :****Fertilizer, Pollution, Production, Rotavator, Seedbed, Indian Soil Testing Manual*

1. 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). It is used for mixing manure or fertilizers into soil and for seedbed preparation. It offers an advantage of superior soil mixing, better pulverisation, rapid seedbed preparation and reduced draft compared to conventional tillage.

1. **Materials and Methods**

For this experiment the entire 9 acre land is divided into18 equal plots. The combination of seedbed preparationand fertilizer used are finalised in 9 different categorieswhich is Table 2 Two plots were selected randomly foreach combination of seedbed preparation and fertilizerfor the experiment, and the final product is combined tomeasure the total output and to compare which is the best combination. The general recommendation for use of chemicalfertilizer is 50kg/acre in agricultural lands as per the Indian soil testing manual released in 2011 by the CentralMinistry of Agriculture, Central Government, India.The chemical fertilizer used in the experiment was Ureaavailable in the local market. When urea is applied to thesoil, it is converted to ammonia; chemical reaction takesplace with water to form ammonium ions within shorttime period of 2 to 3 days (faster under warm conditions).

Naturally occurring organic substance consistingprimarily of minor levels of minerals, gypsum, humic acid and clays. It eases organic material incorporationto the soil, it also accelerating its nutrient utilization anddecomposes at faster rate12.The seedbed preparation of 10 plots was done bymanually and of 8 plots wad done by using rotavator.The chemical fertilizer was used in 9 plots and organicfertiliser was used in 9 plots. The amount of urea(chemical fertilizer) used is divided into three categoriesone is as per the guidelines of Ministry of Agriculture,Central Government, India; i.e. 50kg per acre, otherquantity is much lesser than the guidelines i.e. 35kg peracre and last one is according to actual farmers Practicein the region i.e. 65kg per acre. The quantity of organicfertilizer used is 45kg per acre and 60kg per acre for bothseedbed preparations were done by manually and byusing 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

|  |  |  |
| --- | --- | --- |
| SN | 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 |

1. **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 correlationbetween the concentration of Urea added to soil and theproductivity of crops. The quantity and quality of Pigeon Pea cropsdecreased 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. 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 ratebut 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 2.**Plot wise Pigeon Pea production

**4. Conclusions**

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. 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.

**References**

[1] Kevin Potard, Cécile Monard, Jean-Luc LeGarrec, Jean-Pierre Caudal, Françoise Binet,Organic amendment practices as possible drivers of biogenic Volatile Organic Compounds emitted by soils in agrosystems, *Agriculture Ecosystems and Environment (ScienceDirect)* December 2017, pp. 25-36.

[2] Vanessa CardeñosaEvangelina Medrano Pilar Lorenzo Maria Cruz Sánchez‐Guerrero Francisco Cuevas InmaculadaPradas José M Moreno‐Rojas, Effects of salinity and nitrogen supply on the quality and health‐related compounds of strawberry fruits, *Journal of the Science of Food and Agriculture,*December 2014,pp. 2924-2930

[3] Ashley Leach, Stephen Reiners, Marc Fuchs, Brian Nault, Evaluating integrated pest management tactics for onion thrips and pathogens they transmit to onion, *Agriculture Ecosystems and Environment (ScienceDirect) December 2017*. 89-110

[4] R. H. Patil, M. Laegdsmand, J. E. Olesen, J. R. Porter, Growth and yield response of winter wheat to soil warming and rainfall patterns, *Journal of Agricultural Science,* July 2010, pp. 553-566.

[5] Y. Miao, D. J. Mulla, P. C. Robert,Spatial Variability of Soil Properties, Corn Quality and Yield in Two Illinois, USA Fields: Implications for Precision Corn Management, *Precision Agriculture (Springer),* Volume 7, Issue 1, March 2006, pp. 5-20.

[6] Guangwei Huang, Planning for interrogative management of wastewater disposal, irrigation water supply and fertilizer use: A case study in arid land of China, *Journal of Water Resource and Protection,* 9(3), 2017, 482-492.

[7] KbromAmbachewGebrehiwot, MehariGideyGebrewahid, The need for agricultural water management in Sub-Saharan Africa, *Journal of Water Resource and Protection,* 8, 2016, 835-843.

[8] NidhiRai, Devendra Singh Rathore, PriyankaAshiya, Comparative study of the effect of organic fertilizer and chemical fertilizer on Eiseniafoetida, *International Journal of Innovative Research in Science, Engineering and Technology,* 3(5), 2014,32-38.

[9] M.S. Ullah, M.S. Islam, M.A. Islam and T. Haque, Effects of organic manures and fertilizers on the crop yield of brinjal and soil properties, *Journal of Bangladesh Agril. Univ.* 6(2): 271–276, 2008, 271-276.

[10] SavciSerpil, Investigation of effect of chemical fertilizers on environment, *Sci Verse Science Direct, Proceedia APCBEE, ICESD 2012*: 5-7 January 2012, Hong Kong, 287-292.

[11] S.A. Reinecke and A.J. Reinecke, ―Earthworms as test organisms in Eco toxicological assessment of toxicant impacts on ecosystems, In: Edwards C.A. (ed.): *Earthworm Ecology. CRC Press, Boca Raton*, 299–320, 2004.

[12] SerpilSavci, Investigating effects of chemical fertilizers on environment, SciVersrScience Direct, ICESD 2012: 5-7 January 2012, Hong Kong, *APCBEE Procedia* 1 ( 2012 ) 287 – 292.