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Effect of Rice Husk Mulching on Growth and Yield of Chickpea (*Cicer arietinum* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

During the *Rabi* season of 2022–2023, a field experiment entitled "Effect of rice husk mulching on growth and yield of chickpea (*Cicer arietinum* L.)" was conducted at the Pandit Deen Dayal Upadhyay Institute of Agricultural Sciences, located at Utlou, Bishnupur District, Manipur, in an attempt to ascertain the effects of mulching on seedling emergence and the effects of varying degrees of rice husk mulching on chickpea yield. There are 12 treatments i.e., T_1 – Control (no rice husk mulch), T_2– 10 q /ha, T_3– 15 q /ha, T_4– 20 q/ha, T_5– 25 q/ha, T_6– 30 q/ha, T_7–35 q/ha, T_8– 40 q/ha, T_9 – 45 q/ha, T_{10} – 50 q/ha, T_{11} with 55 q/ha and T_{12} with 60 q/ha of rice husk mulching

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replicated thrice in a Randomized Block Design (RBD). The result shows that mulching with 60 q/ha of rice husk i.e., treatment T_{12} had significant effect on crop's germination percentage. Additionally, the results indicate that the treatment T_{12} – 60 q/ha of rice husk mulching had significantly highest growth and grain yield (17.10 q/ha) as compared to other treatments. Thus, from the experiment it can be concluded that the application of rice husk (60 q/ha) mulching is more favorable for attaining sustainable higher profits and productivity in the cultivation of chickpea during *Rabi* season of Manipur.

Keywords: Chickpea; mulching; germination; growth; yield.

1. INTRODUCTION

Pulses, the grain seed of legumes are an important group of crops in India. The world's biggest producer of pulses is India. About 7–10 % of India's 315.72 million tons of food grains produced in 2020–2021 were from pulses (Ministry of Agriculture & Farmers Welfare, Government of India, 2022). In Manipur the total production of chickpea was 1.8 m t^{-1} and under area 0.7 m ha^{-1}. In 2014–2015, the chickpea yield was 838 kg/ha (Anonymous, 2016). Pulse crop production improves soil health, encourages sustainable agriculture, while utilizing water efficiently. According to estimates, 80 % among the biologically fixed nitrogen utilized in agriculture is fixed by leguminous agricultural plants and the microorganisms that inhabit their root nodules have a symbiotic connection (Burns and Hardy, 1975).

The chickpea (*Cicer arietinum* L.), sometimes referred to as bengal gram or garbanzo beans, is a winter crop that belongs to the Papilionaceae subfamily of the Leguminosae family. The origin of the chickpea has been identified to southeast Turkey. In addition to a secondary center that origin in Ethiopia, four centers of diversity emerged across the Arabian Peninsula, the eastern Mediterranean, Central Asia, & India (Vavilov, 1951). Desi, also called brown gram (*Cicer arietinum* L.), and Kabuli, sometimes called white gram (*Cicer kabulinum*), are the two types of Indian gram. Among them, desi gram is most widely grown. In addition to the impact of the crop's growth conditions, the application of mulch plays a critical role in optimizing germination by conserving soil moisture, suppressing weed infestation, enhances soil quality, and support plant growth. The word mulch originates from a German word "molsch," which means "soft to decay". Mulch is the term used to describe the spread that gardeners make over the ground using straw and leaves (Jacks et al., 1955). It has several applications in agriculture. The main goals of mulch, especially in dry and semi-arid areas, are water saving and erosion control. The mulching practice has been used as a management tool in the world wide. It provides more favourable environment for plant growth and development, and also efficient crop production (Sathiya et al., 2020). Other uses for mulching include adjusting soil temperature, controlling weeds, conserving soil, and adding nutrients for plants after decomposition of organic mulch, improve soil structure, increases crop quality and yield. In this present experiment, rice husk is used as the mulching material which is cheaper and easily available in Manipur. In India, many researchers had researched on chickpea on better agronomic methods and nutrient management. However, mulching in chickpeas has not been thoroughly studied or investigated. Consequently, in light of this, the current experiment entitled "Effect of rice husk mulching on growth and yield of chickpea (*Cicer arietinum* L.)" was undertaken.

2. MATERIALS AND METHODS

The field experiment was conducted at the experimental site of the Pandit Deen Dayal Upadhyay Institute of Agricultural Sciences situated in Utlou, Bishnupur District, Manipur, during the *Rabi* season of 2022–2023 which is at 24°43'23"N latitude & 93°51'33"E longitude and situated near the elevation of 790 meters above mean sea level (MSL). The soil of the experimental site had a pH of 5.2, was clayey, medium fertility. The soil's chemical composition revealed that it had high organic carbon content (1.04 %), medium levels of phosphorus (254 kg ha^{-1}) as well as potassium (38.47 kg ha^{-1}) and moderate available nitrogen (296.81 kg ha^{-1}). During the period of experimentation, the monthly maximum and minimum temperature were between 23ºC to 30.6ºC and 5.5ºC to 19ºC, respectively. The surroundings were somewhat conducive to the formation and growth of chickpea with total rainfall of 200.7 mm during the cropping period. There are twelve treatments and three replications laid out in the Randomized Block Design (RBD). The treatments were: T_1 (control, no rice husk mulch), T_2 (10 q/ha), T_3 (15 q/ha), T_4 (20 q/ha), T_5 (25 q/ha), T_6 (30 q/ha), T_7 (35 q/ha), T_8 (40 q/ha), T_9 (45 q/ha), T_{10} (50 q/ha), T_{11} (55 q/ha), and T_{12} (60 q/ha) mulching with rice husk respectively. A consistent dosage of 25 kg N per hectare (urea), 50 kg P_2O_5 per hectare (single super phosphate), and 20 kg K_2O per hectare (muriate of potash) were applied to all treatments including control on the day of sowing. The biometric observations on different characteristics *viz*., germination percentage, plant height, No. of branches were recorded at various crop growth period. The grain yield (kg/ha) was also recorded from each net plot at harvest.

2.1 Germination Percentage

The germination percentage is obtained from the total number of seeds sown and number of seeds germinated as indicated below:

$$\text{Germination percentage (\%)} = \frac{\text{Seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

2.2 Plant Height (cm)

For each treatment and replication, the height of five plants were randomly selected and tagged plants were measured at 30, 60, 90 DAS and at harvesting stage from the ground level to the tip of the plant and average plant height was worked out and expressed in centimeter.

2.3 Number of Branches per Plant

Numbers of branches were counted from the five randomly selected plants at each observation i.e. 30 and 60 DAS. The values of the five plants were averaged.

2.4 Grain Yield (q/ha)

Net plot yield of dry seed yield were recorded in kilogram and expressed in quintal per hectare.

2.5 Statistical Analysis

Mean values of data obtained from the experiment were computed for statistical analysis to test significance and interpretation of results. The statistical significance of various affects was tested 5 percent level of probability (Gomez and Gomez, 1984).

3. RESULTS AND DISCUSSION

3.1 Effect of Rice Husk Mulching on Germination Percentage

Table 1 demonstrates the germination percentage as influenced by rice husk mulching in chickpea crop on the seventh and fourteenth days after sowing. Between treatments, rice husk mulching had no significant effect on the germination percentage on the seventh day. However, treatment T_{12} with 60 q/ha of rice husk mulching had significantly highest germination percentage (88.33 %) on the fourteenth day, and T_{12} is par with T_{11} and T_{10}, T_9 with T_8, and T_6 with T_5, T_4 and T_3. However, in the absence of rice husk mulching, significantly lower germination percentage (79.08 %) was recorded in control (T_1). The majority of the highest germination noted in mulched condition might be because of more ambient soil temperature, optimal soil moisture content and reduction in soil compaction around the seeds under mulch, which helps in better germination and emergence of the chickpea plant. Similar results under mulch were also found to be in agreement with Ramakrishnan et al., (2006), Younus et al. (2017), Thakur et al., (2020), Abonmai et al., (2023) & Minh et al., (2023).

3.2 Effect of Rice Husk Mulching on Plant Height

The height of the chickpea plant was greatly impacted by mulching with rice husk throughout the growing period as presented in Table 1. At 30 DAS, among all treatments T_{12} with 60q/ha rice husk mulching produced significantly taller plant (8.67 cm) over other treatments. Here T_9 is at par with T_8 and T_7, T_6 with T_5 and T_4 is at par with T_3. Again at 60 DAS, T_{12} with 60q/ha rice husk mulching produced significantly taller plant (22.33 cm) over other treatments and T_8 is at par with T_7 and T_6 and T_4 is at par with T_3. Additionally, it was discovered that the plant height had significant effect at 90 DAS and at harvest. The highest plant heights, measuring 36.87 cm and 47.33 cm, respectively were noted from T_{12} (60 q/ha rice husk mulching). However, the shortest plant height (5.47 cm, 9.60 cm, 23.47 cm and 37.20 cm, respectively) was observed in T_1 (no rice husk mulching) throughout the growing period. The higher plant height might be due to more soil water content that was preserved, inhibited the development of weeds, which, in contrast to the control, decreased competition and soil nutrient loss. The outcomes were consistent with the conclusions of Deka et al., (2021), Hidayat et al., (2019) and Yadav et al. (2006). Eze et al. (2019) noted that application of surface mulch can reduce the evaporative losses resulting in significantly higher moisture content. Soil moisture over time retention, improved soil fertility, increased soil temperature, and decreased leaching losses are all made possible by mulches. The findings were also consistent with those of Arche et al., (2022), Daleshwar et al., (2017).

3.3 Effect of Rice Husk Mulching on Number of Branches

The data on the number of branches was influenced significantly by the rice husk mulching as shown in Table 1. At 30 DAS, significantly maximum number of branches (2.53) was recorded in T_{12} with 60 q/ha rice husk mulching over other treatments while, T_6, T_5 and T_4 were found to be at par with each other and T_3 is at par with T_2. Similarly at 60 DAS, T_{12} with 60 q/ha rice husk mulching was recorded with significantly maximum number of branches (4.27) over other treatments. Here T_7 is at par with T_6, T_5 and T_4. However, minimum number of branches (1.20 and 2.37, respectively) was recorded in T_1 with no rice husk mulching. This might be because of the optimal soil moisture content and nutrients, which contribute a more favourable soil environment for crop growth resulting in a greater quantity of branches on each plant. In the treatment without mulching (T_1), the fewest branches were noted. According to similar findings, Arche et al., (2022) & Daleshwar et al., (2017) who revealed that more branches were produced by mulched plant than that of no mulched plant (control).

3.4 Effect of Rice Husk Mulching on Grain Yield

From the Table 1 it can be observed that the mean grain yield was influenced significantly by different treatments of mulching. Among the different treatments, T_{12} with 60 q/ha rice husk mulching was significantly recorded the highest grain yield (17.10 q/ha) while T_9 is at par with T_8, T_7 with T_6 and T_4 is at par with T_3. However, T_1 without rice husk mulching showed a noticeably reduced grain production (8.83 q/ha). The increased grain yield may be the result of better soil moisture conservation from increased infiltration. This improves soil moisture retention, which promotes ideal photosynthesis, nutrient absorption, and transpiration. Additionally, it prevents weeds from growing, which enhances crop development and growth. The outcomes is supported by the findings of Sajid et al., (2013), they discovered that by decreasing weed development, increasing soil temperature, and maintaining soil moisture, the use of organic mulches increased chickpea grain output. Additionally, the outcomes matched those of Teame et al. (2017), Anand et al., (2020) & Abonmai et al. (2023).

Table 1. Effect of rice husk mulching on germination percentage, plant height, number of branches and grain yield

Treatment	Germination. Percentage (%)		Plant height (cm)				Number of branches		Grain yield (q/ha)
	7th day	14th day	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	
T_1	46.00	79.08	5.47	9.60	23.47	37.20	1.20	2.37	8.83
T_2	46.67	80.08	5.80	12.10	24.00	38.20	1.33	2.67	10.67
T_3	46.58	81.25	6.27	13.80	25.33	39.30	1.40	2.87	11.50
T_4	46.08	82.08	6.40	14.00	26.00	39.83	1.53	3.13	12.23
T_5	47.33	82.50	6.73	14.40	26.80	40.67	1.60	3.17	12.43
T_6	46.25	83.00	6.90	15.20	28.00	42.60	1.63	3.20	13.43
T_7	47.83	83.75	7.17	15.53	28.47	42.93	1.77	3.23	13.73
T_8	46.33	84.42	7.20	15.80	28.93	43.20	1.93	3.43	14.97
T_9	46.75	85.00	7.33	16.90	30.13	44.53	2.10	3.63	15.23
T_{10}	48.17	86.25	7.60	17.97	32.87	45.33	2.27	3.83	16.00
T_{11}	47.00	87.00	8.07	18.80	35.47	46.57	2.40	4.07	16.63
T_{12}	51.17	88.33	8.67	22.33	36.87	47.33	2.53	4.27	17.10
SEm±	3.77	0.34	0.08	0.12	0.18	0.14	0.04	0.05	0.15
CD (*P*=.05)	NS	0.98	0.24	0.34	0.53	0.41	0.10	0.14	0.44

4. CONCLUSION

In light of this experiment's findings, it may be claimed that using rice husk mulch improved chickpea growth and enhanced the grain yield. Significantly higher grain yield of 17.10 q/ha with better growth could be obtain from 60 q/ha of rice husk mulching in chickpea plant. The higher yield under mulch treatment might be because of the fact that organic mulches helps to preserve soil moisture, raise soil warmth, and have a positive impact on weed control. These findings underscore the potential of organic mulching as a sustainable agricultural practice for enhancing chickpea production.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

I, Laikangbam Budhirani hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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