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Impact of Organic Mulching on the Performance of Lentil Cultivars in Drought-prone Rabi Season of Meghalaya

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Authors' contributions

This work was carried out in collaboration between both authors. Author KS designed the study, guided author LIPR for research, corrected analysis, wrote the protocol. Author KS wrote the manuscript, conducted the experiment and wrote the first draft of the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: Mulching effectively conserve soil moisture and effects soil temperature which influence crop growth and yield. The present investigation was conducted to study the effect of different organic mulches on the growth and yield of lentil crop during winter season.
Study Design: Split-plot design.
Place and Duration of Study: The experiment was conducted during the rabi season (November, 2021–April, 2022) at College of Post Graduate Studies in Agricultural Sciences, Umiam,

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Meghalaya, India. Lentil is a winter season crop well suited for cultivation in North Eastern Hill regions of India.

Methodology: The experiment was conducted in split plot design with four different varietal treatments of lentil (V1-HUL-57, V2-PL-4, V3- PDL-1 and V4-PSL-9) (sub plots) was studied under four different organic mulching (main plot), viz., M0- unmulch, M1- paddy straw mulch, M2-maize stover mulch, M3-weed mulch. Lentil performed better under paddy straw mulch followed by weed mulch, maize stover mulch and un-mulch.

Results: The growth parameters, viz., plant height (27.03 cm), branches plant-1 (4.82) and dry matter accumulation plant-1 (2.61 g) were found significantly higher for PL-4 variety. The economic yield of the variety PL-4 was reported 717.5 kg ha-1 which was highest over the other varieties. The economic yield under the paddy straw mulch was reported significantly highest (723.3 kg ha-1), which is 6.51, 11.6 and 21.01% highest over M3, M2 and M0, respectively. The benefit-cost ratio was reported highest for paddy straw mulch (1.81) for a variety PL-4 (1.79).

Conclusion: Paddy straw mulch significantly improves the growth and yield parameters of lentil crop in Meghalaya, a region characterized by frequent drought during the winter. This technique not only improve crop growth and yield, but also supports sustainable agriculture practices in hilly ecosystem, which is vulnerable to climate change.

Keywords: Lentil; varietal treatments; organic mulch; hill ecosystem.

1. INTRODUCTION

Plant protein happens to be one of the most remedial measures to meet the nutritional requirements of ever-growing population (Wang et al. 2021). Pulses play a key role in terms of food supply, nutritional security and environmental sustainability (McDermott J. and Wyatt A.J. 2017). Pulses can be grown throughout the year in India, despite of its diverse agroclimatic conditions. India contributes 33% and 22% to world area and production of pulses, respectively (Reddy et al. 2023). Lentil (*Lens culinaris*) is an annual bushy plant belongs to Leguminosae family and has lens shaped seeds They are good source of protein (20–45%), carbohydrates (60%), fiber (5–37%) along with vitamins and essential amino acids, (Dikshit et al. 2022; Singh et al. 2013). Lentil is a hardy crop, can be cultivated even under extreme winters and frost conditions with optimum temperature ranges from 18 to 24^{o}C (Araujo et al. 2015). Lentil is cultivated in 18.00 lakh ha area of India with production and productivity of 11.00 lakh tons and 611 kg ha-1, respectively (Annonymous, 2014). Though, North East Region (NER) receive ample amount of rainfall annually, 70% of which is confined to rainy season, therefore winter crop undergoes drought stress (Kuotsu et al. 2014). Most of the area kept fallow in NER after the rainy season rice crop (Gautam et al. 2021). As lentil is a hardy crop, there is a wide scope for its cultivation under rice fallow conditions of NER (Ghosh et al. 2016).

Crop residue, or the biomass left over after a crop is harvested, is the most readily available and accessible. For agricultural soils, crop residue is regarded as "the major source of soil organic matter" (Osorioet al. 2017; Huang 2017). Rice (*Oryza sativa* L.), sorghum (*Sorghum bicolor* L.), maize (*Zea mays* L.), and wheat (*Triticum aestivum* L.) are some of the primary cereal crops that generate a considerable amount of crop residue. Around 219 million ha of wheat, 201.2 million ha of maize, 154 million ha of rice, and 40.25 million ha of sorghum were harvested globally in 2020 (Annonymous (2020). Maize and wheat together make the main source of 40% of food consumption worldwide and obtain 25% of calories, for people in developing countries (Grote et al. 2020). Incorporation or retaining of crop residue on the soil surface has number of advantages for soil quality (Klopp H.W. and Blanco-Canqui H. 2022). Small farmers in developing countries are facing many trade-offs in managing agricultural crop residue (Valbuena et al. 2015). Residues may be completely removed for the use as biofuel or livestock feed and farmers may also burn crop residues to prepare the field for planting (Ali et al. 2019). A change over the traditional crop residue management contribute to environmental (Kumar et al. 2023) and economic benefits for retaining crop residues. Moisture stress during winter season is one of the main parameters and drawback for increasing cropping intensity in Meghalaya (Balusamy et al. 2024). There are many benefits for mulching of organic residues in agriculture (El-Beltagi et al. 2022); Duan et al. 2022), viz., reduces surface evaporation, increases water use efficiency, yield, profitability and decreases weed pressure on crop to a

greater extent and also increases organic matter content of the soil (Waheed et al. 2023). Mulching also conserve soil loss caused due to runoff (Fan et al. 2023), improve soil physical condition (Ahmad et al. 2022) and ultimately increases the productivity of the crop (Iqbal et al. (2020)). *In-situ* soil moisture stress can be reduced by the use of different organic mulches (Teame et al. 2017; Marwein and Ray 2019). Considering the scenarios mentioned above, a field experiment was conducted to evaluate the performance of lentil varieties under organic mulches with the objectives to evaluate the performance of lentil varieties.

2. MATERIALS AND METHODS

The experiment was conducted during rabi season (November, 2021–April, 2022) at College of Postgraduate Studies in Agricultural Sciences, Ri Bhoi district, Meghalaya, India. The experimental site is situated at 91o 18' to 92o 18' East longitude and 25o 40' to 26o 20' North latitude and at an altitude of 950 m above the mean sea level (MSL). The schematic representation of the experimental site is shown in Fig. 1. The climate of Ri-Bhoi is classified as subtropical humid type with high rainfall and cold winters. The Monsoon rainfall is normally sets in at the first fortnight of June and extends up to end of September. The maximum temperature rises up to 30oC in the months of July-August and minimum falls down to 5 to 6oC during the first week of January. The weekly rainfall (mm), average maximum and minimum temperature (oC) and relative humidity (%) is shown in Fig. 1. Following was the range of variation for monthly mean temperature and monthly mean relative humidity (RH) during the crop growth period (November-March), Tmax-Tmin (oC) 29.24oC–20.28oC and RH (%) 66.7–85.9%. Total rainfall recorded during the crop growth period was 137.7 mm. The soil type is sandy clay loam, acidic reaction (pH-4.86) and high soil organic carbon content (1.13%). The experiment was carried out under split plot design with four main-plot treatments (mulches), viz., i) un-mulch, ii) paddy straw mulch, iii) maize stover mulch, iv) weed mulch are applied @5 t ha-1 and four sub-plot treatments (varieties), viz., i) HUL-57, ii) PL-4, iii) PDL-1 and iv) PSL-9 and the experiment was replicated three times. Mulching was done on the next day of sowing in the respective experimental plots.

The source of the variety HUL-57 is Banaras Hindu University (BHU), Varanasi. This variety is mainly adopted by Eastern and central U.P, Bihar, Jharkhand, West Bengal and Assam. Average yield of this variety is 1.4 t ha-1. It is a small seeded variety, resistant to rust and wilt. The variety PL-4 is adopted mainly in North West Plain Zones which include Punjab, Haryana, Delhi, West Uttar Pradesh and North Rajasthan. The average yield of this variety is 1.6 t ha-1. This variety is resistant to rust and tolerant to wilt. The varieties PDL-1 and PSL-9are released recently in 2019 by Central Soil Salinity Research Institute, Karnal, Haryana in collaboration with Indian Agricultural Research Institute (IARI), New Delhi. These varieties are mainly adopted in North West Plain Zones and

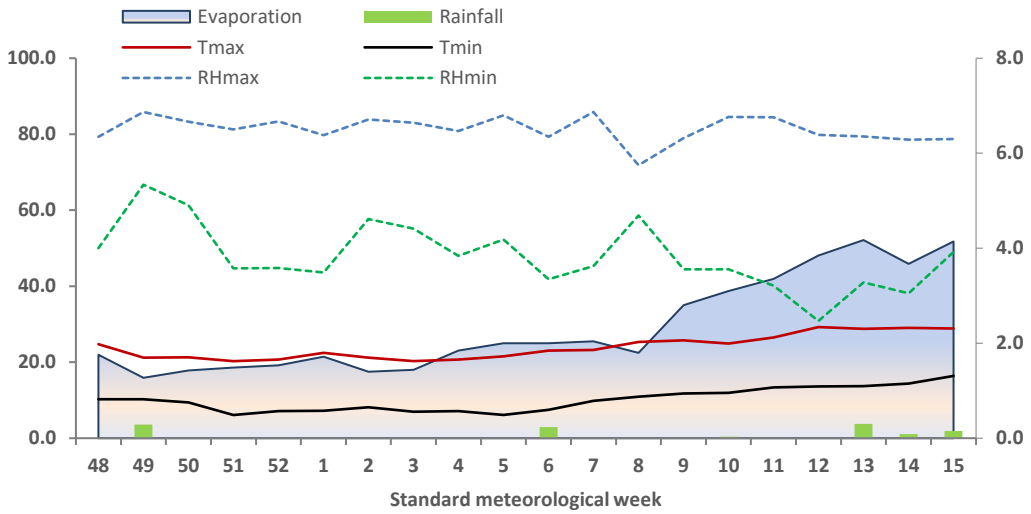

Fig. 1. Observed Meteorological data during the experimental period (rainfall and evaporationis included in secondary axis)

North East Plain Zones. The varieties PDL-1 and PSL-9 are mainly suitable for moderate salinity affected soils. From each plot 5 plants were selected randomly and were tagged to be the sampled plants excluding the plants of border rows. All the observations recorded with respect to growth and yield attributes of lentil varieties made from tagged plants. The growth parameters were recorded at 30, 60 and 90 days after sowing (DAS) while yield attributes were recorded at the time of harvesting. The data obtained from various studies during investigation were statistically analyzed by using the technique of analysis of variance for split plot design over the computer. The yield of net plot was calculated by adding the yield of each sample plants. The total pod yield hectare-1 was obtained by converting the yield of the net plot area into a hectare.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

3.1.1 Plant height

The plant height was recorded significantly highest under paddy straw mulch (28.18 cm) over the entire crop season compared to control. However, the plant height under maize stover mulch and weed mulch were at par with paddy straw mulch. The highest plant over the entire season is been recorded at harvest stage of the crop. At 30 DAS, among the main plot treatments, the plant height was recorded significantly highest in M1 (7.67 cm) compared to M0 (6.72) and is at par with M3 (7.54) and M2 (7.46). Similar trend was observed in main plot treatments at 60 and 90 DAS and at harvest of the crop presented in Fig. 2a. The reason might be due to better soil moisture availability and better regulation of soil temperature under mulching as compared to un-mulch or control. The plant height of soybean increased by 6.94%, 14.7%, and 25.8%, under straw mulching of 0, 4.8, 7.2 and 9.6 t ha-1, respectively (Liu et al., 2023; Qu Y. and Fang B. 2020) reported a positive correlation between straw mulching on yield plant height, soil temperature in buckwheat crop. Straw mulching could boost soil organic carbon, accumulated temperature, water use efficiency, and temperature, all of which would support crop development and yield. Maize straw mulch has reported 4 to 7 cm higher plant height over control in potato crop (Li et al. 2024). At 30 DAS, among the sub-plot treatments, significantly highest plant height was observed in V2 (7.73 cm) over V1 (7.27 cm) and V4 (6.88 cm) but it is at par with V3 (7.51 cm). Similar pattern was observed at 60 DAS, where the plant height in V2 (21.66 cm) recorded significantly highest over V1 (20.22 cm) and V4 (19.91 cm) but it is at par with V3 (21.01 cm). At 90 DAS, significantly highest plant height was recorded in V2 (27.03 cm) over V4 (25.11 cm) and V1 (25.09 cm) but it is at par with V3 (26.76 cm) (Fig. 2b.). These results are also supported by (Sharma and Sharma, 2003; Shirisha et al., 2023) also reported that higher growth rate of vegetable pea under mulched conditions is due to a greater number of nodules plant-1, higher root. The variety PL-4 (27.03 cm) has shown highest plant height over other varieties during the entire crop season. (Bharadwaj S. and Bharadwaj S. 2022) conducted experiment over six varieties of wheat under no mulch and rice straw mulch reported highest plant height in the variety WH 1142 over the other varieties. The likely cause of increase in plant height in one variety over the other is due to their distinct genetic traits (Belete et al. 2018; Parida et al. 2023; Shirisha et al. 2023). The reason may be due to genetical traits of a variety and the location at which it grows. Parida et al. (2023) reported that variety VM 12 of garden pea crop reported highest plant height and branches over other varietal treatments (VM 10, VLSM 12, VLSM 13). Arka Suvidha variety of French bean has reported highest growth and yield (Das et al. (2014)) over Abhay, Anupam etc. According to Liasu M.O. and Achakzai A.K.K. (2007), mulching with leaves from Tithonia diversifolia encouraged the growth (including plant height) and development of potted tomato plants. Ray et al. (2023) also reported that mulching improved water productivity and yield of pulses.

Although environmental factors and agricultural techniques also have an impact on the number of branches plant-1, branching is mostly a genetic trait. Paddy straw mulch has shown highest branches number plant-1 (4.86) then by weed mulch (4.40), maize stover mulch (4.25) and un-mulch (4.12). Similar results where, mulching had a significant effect on branches plant-1 over control was reported by Singh at al., 2019 in summer Mash (Vigna mungo). The reason may be the influence of soil moisture on plant growth under mulched treatments lead to more growth thereby a greater number of branches. The greatest number of branches (22.00) per plant was produced by 9 t/ha of straw mulching; nevertheless, there was no statistically significant difference with 6t/ha straw mulching, no straw mulch had the fewest branches per plant (11)

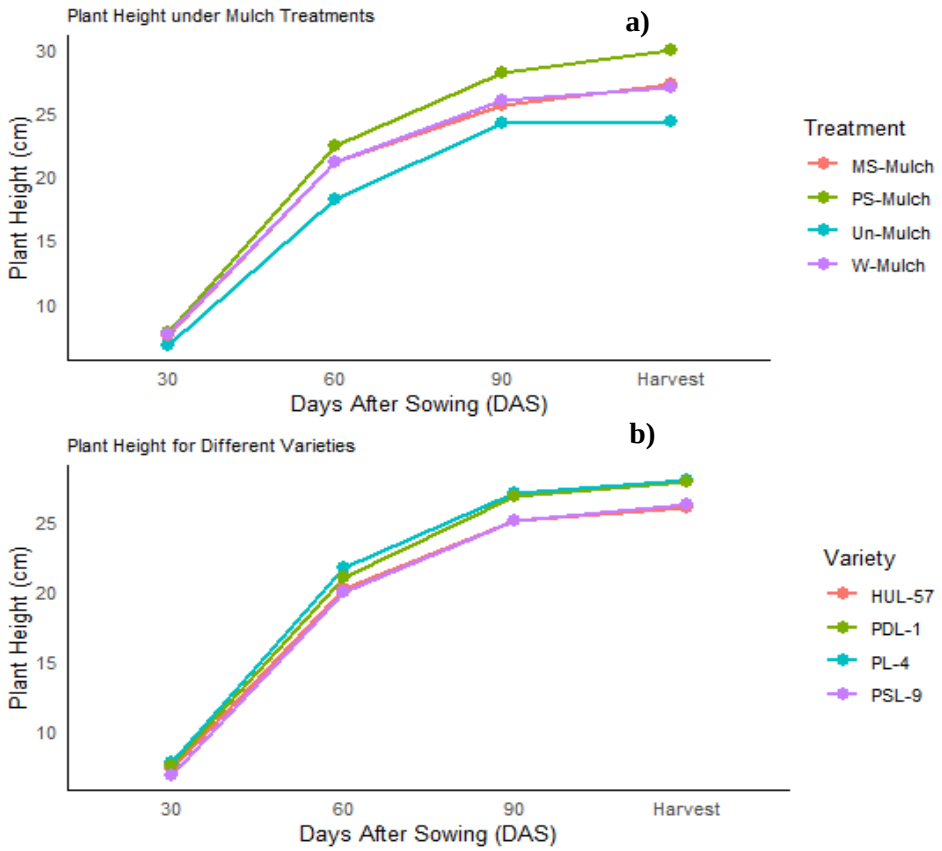

Fig. 2. Effect of mulching (a) and varietal treatments (b) on plant height at 30 days interval

and did not exhibit any statistically significant differences. There may be more branches per plant when irrigation water is increased mostly because improved soil moisture availability promotes cell division and elongation, which improves plant vegetative development in hot pepper (Demo A.H, and Tsehai K.K. 2024). Pathak et al. (2024) also reported that, paddy straw mulch reported higher number of hills over the control in potato crop. The variety PL-4 (4.82) recorded highest number of branches plant-1. The number of branches plant-1 is chiefly a genetic trait but also influenced by climatic condition and cultivation practices. The results are agreed by Pandey et al., (2011); Yadav et al., (2015) where areported that variety's genetic potential interacts with the environment in which it grows and agricultural practices to result in plant development, which includes the number of branches. The findings demonstrated how genotype and growth conditions influenced the number of branches in various kinds in French bean crop. Rebouh et al. (2023) reported that along with genetic potential of varieties, good agricultural practices would also help in increase in growth and development of the wheat crop.

3.1.2 Dry matter

The results were found non-significant among the mulches for dry matter accumulation at 30 DAS, however, highest value of dry matter was recorded in M1 (0.082 g) followed by M3 (0.079 g), M2 (0.078 g) and M1 (0.077 g). At 60 DAS significantly highest value dry matter was observed in M1 (1.21 g) over M2 (1.08 g) and M1 (0.96 g), but is at par with M3 (1.13 g). At 90 DAS, significantly highest dry weight was reported in M1 (2.61 g) over M2 (2.38 g) and M1 (2.28 g) but is at par with M3 (2.54 g) (Fig. 3 a.). Similar pattern was observed at harvest whereas significantly highest dry matter accumulation of 3.72 g observed in M1. Dry matter accumulation in lentil was reported significantly highest after 60 days after sowing during entire crop season under paddy straw mulch treatment. Nandi et al. (2024) reported significantly highest dry matter, CGR, RGR, NAR in lentil crop under straw mulched condition over the control. Sub-surface drip irrigation along with legume straw incorporation reported higher dry matter accumulation in maize crop (Singh et al. (2024)). Among the varietal treatments, at 30 DAS, no

significant difference was observed, at 60 DAS, V2 (1.18 g) (statistically at par with V3 (1.11 g)) has reported significantly highest value of dry matter over V1 (1.08 g) and V2 (1.02 g). The similar trend was observed at the time of harvest. The dry weight accumulation is increasing till maturity, thereafter decreases till harvest due to utilization of dry matter for the production of economic yield up to harvest. The reason might be the better plant growth and development due to better soil moisture availability under paddy straw mulch. Similar results were supported by the research findings of Singh T. and Rana K.S. (2006); Patil et al., (2011). Higher dry matter accumulation in leaves and stems during vegetative and reproductive crop growth phases, as well as its correlation with higher dry matter plant-1 with rain water conservation practices (Patil et al., (2011)). Significant results were found for dry matter accumulation among the varietal treatments. The reason might be due to genetic variation which is inherently affected in different genotypes and also influenced by prevailing climatic conditions. While the genotype and genotype and environment interaction (GEI) accounted for 28.84% and 26.54% of the overall variation, respectively, the environment's primary effect explained 44.62% in oat genotypes (Kebede et al. 2023). The results are agreed by the research findings of Shirisha et al., (2023); Das et al., (2014). The effect of mulching has shown significant effect on crop growth rate (CGR) during the initial period, thereafter the results was non-significant as shown in Table 1. This shows that, the mulches influenced the rate of dry matter production only during vegetative growth stage. The number of leaves per plant would most likely be one of the contributing elements to the higher production of dry matter as a result of the growth of a larger leaf area, which increases the capability for photosynthesis. Mon M.M. and Oue H. (2023) reported higher dry matter in spinach in Plant + mulch treatment over Plant only treatment. More biomass can be produced as a result of improved canopy photosynthesis brought about by larger leaf area. During the vegetative stage under half mulching and plastic mulching patterns, favourable soil hydrothermal conditions boosted light interception, accelerated leaf expansion, and encouraged biomass buildup in sun flower crop (Jing et al. 2024). The reason may be due to highest dry matter production during vegetative stage of the crop and then decreases at reproductive stage up to harvest. These results are supported by Devi, (2008). CGR was recorded significantly highest under the variety PL-4 as presented in Table 1. The reason may be the high yielding varieties shown highest rate of growth than other varieties.

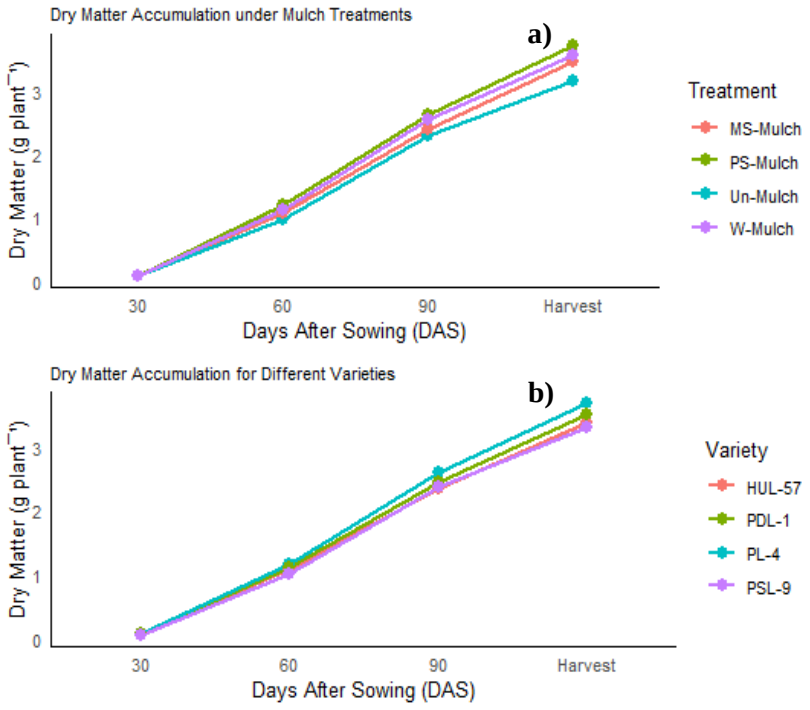

Fig. 3. Effect of mulching (a) and varietal treatments (b) on dry matter accumulation at 30 days interval

3.1.3 Root shoot ratio

Root and shoot dry weight of individual plants was estimated at 30, 60, 90 DAS, accordingly a ratio was done and presented in Fig. 4. for different treatments. Among main plot treatments, at 30 DAS significantly highest root-shoot ratio was recorded in M1 (0.278) over M0 (0.195) and is at par with M3 (0.268) and M2 (0.245). At 60 and 90 DAS non-significant results were obtained (Fig. 4a.). Cotton root-shoot increased by 10.2% with the increasing planting density in film mulching and no mulching treatment (Cao et al. 2024). At the timepoints before to 80 DAS of maize crop, the root:shoot ratio in rotary tillage with mulch were greater than those of no tillage with mulch, and dropped as maize grew (Zhang et al. 2023). crop roots are essential for increasing crop yield by increasing the rate of nutrient uptake (Wang et al. 2015). Nevertheless, the root system also serves as an essential storage organ, a function that has not received enough attention. Among, the sub-plot treatments, at 30 DAS significantly highest root-shoot ratio was recorded in V2 (0.289) over V4 (0.240), V3 (0.230) and V1 (0.228). Significantly highest root-shoot ratio was recorded in V2 (0.480) over V1 (0.406), V3 (0.403) and V4 (0.353) at 60 DAS. At 90 DAS V2 (0.584) reported significantly highest root-shoot ratio over V3 (0.532) and V4 (0.522), but is at par with V1 (0.564) (Fig. 4b.). Paddy straw mulch reported significantly highest root-shoot ratio over the control, which is at par with weed mulch and maize stover mulch. This indicates that root dry weight is recorded highest under organic mulch as compared to un-mulched treatments. Dhaka et al., (2023) reported that the green gram variety MH 1871, reported 4 and 6% of higher shoot and root dry weight respectively over MH 1762 and MH 1142 varieties under different irrigation regimes.

Mulching promote soil moisture conservation helps in better root and shoot growth. Maruthi et al., 2024) reported that resource conservation measure increased the rooting depth by 5 cm while organic amendments increased root length density (RLD) of drought resistant varieties of moong bean. The paddy straw mulch reported significantly highest root-shoot ratio over control treatment also reported by Parida et al., (2023). Mulching lead to better moisture conservation and promotes efficient nutrient uptake inturn enhance root proliferation, promoting stem diameter plant height, and other growth parameters (Li et al., 2020). Zhang et al. (2024) reported that degradable mulch was more conducive to the growth of the spring maize root shoot and coordinated the root shoot ratio than plastic film mulch. Maintaining maize stover and bio-mulches enhances the availability of nutrients for subsequent crops, retains water in the root zone, promotes root growth, and eventually improves crop output (Das et al. 2017).

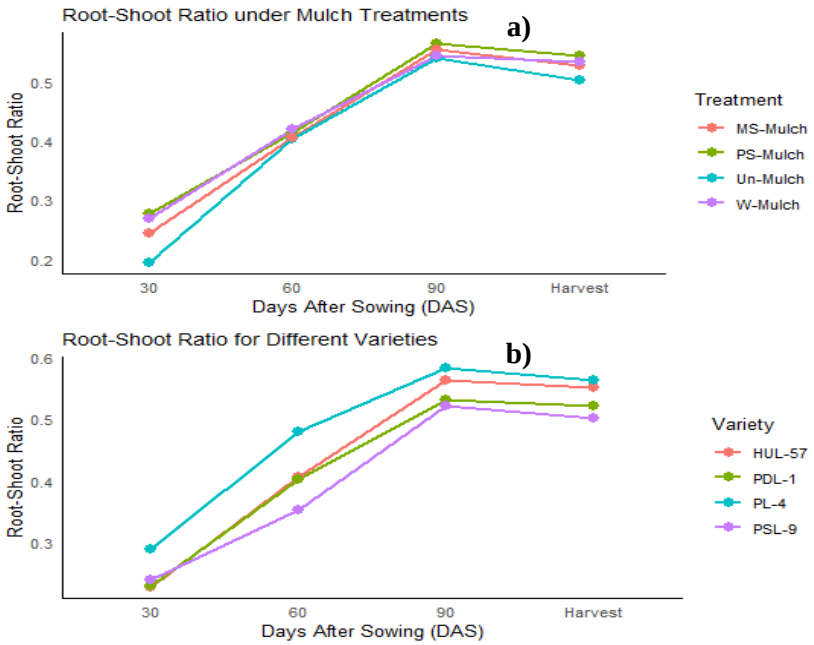

Fig. 4. Effect of mulching (a) and varietal treatments (b) on root-shoot ratio at 30 days interval

Table 1. Yield parameters of lentil cultivars under different organic mulching

Treatments	Pods plant^{-1}	Seeds pod^{-1}	Test weight (g)	Economic yield (kg ha^{-1})
Main plot (Level of mulching = 04				
Un-mulch	36.21	1.64	22.73	571.3
Paddy straw mulch	43.57	1.67	23.12	723.3
Maize stover mulch	38.18	1.59	22.73	638.7
Weed mulch	41.29	1.63	22.75	676.2
S.E.(m) ±	**0.94**	**0.02**	**0.66**	**27.3**
CD (*P* = .05)	**3.24**	**NS**	**NS**	**94.6**
Sub-plot (Level of variety = 04)				
HUL-57	40.37	1.65	20.18	604.0
PL-4	39.78	1.63	24.02	717.5
PDL-1	41.92	1.66	21.55	643.6
PSL-9	37.18	1.59	25.58	644.4
S.E.(m) ±	**0.88**	**0.03**	**0.37**	**21.5**
CD. *P* = .05)	**2.57**	**NS**	**1.07**	**62.7**

3.1.4 Yield parameters

Table 1 presents the yield and yield parameters of lentil cultivars under different treatments. Significant results were found for number of pods plant-1, where paddy straw mulch recorded highest pod number and the lowest pod number was reported by un-mulch treatment (Table 1). This may be due to better soil moisture availability under mulched conditions lead to better plant growth and development compared to unmulched condition. Monneveux et al. (2006) reported that, water stress at reproductive stages of the plant reduces the yield and yield parameters. Paul et al., (2021) reported that rice straw mulch decreased soil cracking and soil penetration resistance while also raising soil water content. These changes were linked to a 23% increase in sunflower production as well as a rise in the development of shallow roots. Since mulching has been practiced plants have adequate moisture supply during the maturity stages. Jayakumar et al., (2024) reported 22.8% higher yield of turmeric under mulching than the control treatments. The possible reasons might be better germination, soil moisture retention, weeds control, increased water and nutrient use efficiency under mulched conditions (Reddy et al., 2017)). The results were also found significant among the varieties, where the variety PDL-1 (43.57) recorded the highest number of pods plant-1. The reason might be that, there is a correlation between number of branches plant-1 and pods plant-1, where the variety PL-4 recorded the highest branches plant-1 which is on par with PDL-1. Significant results among different varieties of crop for number of pods plant-1 was also reported by Gupta et al., (2006); Mondal et al., (2011) There is a strong positive correlation between N, P and K uptake (kg ha–1) and seed yield of chickpea, lentil and lathyrus under mulching (Dey et al., 2022). It might be due to mulch improving soil moisture and nutrient availability to plant roots, leading to higher grain and stover yield of pulse crops.

The results for seeds pod-1 were reported non-significant in both under mulch and varietal treatments. The different mulch levels had no effect on the seeds plant-1. The non-significant results for seeds pod-1 under different varietal treatments was also reported by Biswas et al., (2002). The results were observed non-significant for the test weights among the mulching treatments. Similar finding was also supported by Marwein and Ray (2019). Variety PSL-9 recorded significantly highest test weight (25.58 g) over other varieties. The reason for this may be attributed to the genotype of the variety as of bold size seeded variety results in more test weight. Similar results were reported by findings of Zamir et al., (2013); Das et al., (2014). The significant results were reported among mulch treatments for economic yield. Paddy straw mulch reported significantly highest economic yield of 723.3 kg ha-1 over the control (571.3 kg ha-1), however, it is at par with weed mulch (676.2 kg ha-1) and maize stover mulch (638.7 kg ha-1). These results may be due to adequate soil moisture availability which promote better uptake of nutrients form soil and helps in better performance of the crop under mulched condition. The results are supported by findings of Karunakaran V. and Behera U.K., (2013); Reddy et al., (2016). This may be explained by the plant's capacity to take up the necessary nutrients and moisture from the soil. The presence of soil moisture in the edaphic zone of

Table 2. Economic parameters of lentil cultivars under different organic mulching

Treatments	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	BCR
Main plot (Level of mulching = 04			
Un-mulch	29,138	8,433	1.41
Paddy straw mulch	36,890	16,485	1.81
Maize stover mulch	32,572	11,667	1.56
Weed mulch	34,485	14,580	1.73
S.E.(m) ±	1,394	1,394	0.07
CD (*P* = .05)	4,823	4,823	0.23
Sub-plot (Level of variety = 04)			
HUL-57	30,805	10,525	1.52
PL-4	36,593	16,153	1.79
PDL-1	32,822	12,182	1.59
PSL-9	32,865	12,305	1.60
S.E.(m) ±	1,096	1,096	0.05
CD (*P* = .05)	3,200	3,200	0.16

the plant in accordance with its requirements made it feasible for soil nutrients to be available, leading to greater yield component and grain yield (Marwein and Ray, 2019). Among the varietal treatments, significantly highest economic yield was reported by PL-4 (717.5 kg ha-1) over PSL-9 (644.4 kg ha-1), PDL-1 (643.6 kg ha-1) and HUL-57 (604.0 kg ha-1). The significant results for economic yield among the varietal treatments of rajma crop was accepted and reported by Marwein Y. and Ray L.I.P., (2019). Rajma cultivars also showed notable seed yield results, with Selection-9 outperforming other types. This may be because the genotype of the particular variety had seeds that were larger, had more seeds pod-1, and had a higher bearing capacity plant-1 (Marwein and Ray, (2019). The effects of the genes TaGW8, Rht8, and Ppd-D1a on characteristics linked to wheat yield these genes are directly associated with advantageous agronomic characteristics in wheat, which increase wheat crop yield (Ma et al. (2019); Zhang et al. (2019)). In comparison to no mulch cropping, the addition of crop residue and its subsequent breakdown released nutrients into the soil for plant absorption, improving the yield of all the crops that were grown (Dey et al. 2022).

3.1.5 Benefit-cost ratio

The various economic parameters like gross return, net return and benefit cost ratio (BCR) are presented in Table 2. Significantly highest gross returns, net returns and BCR was reported for paddy straw mulch are Rs. 36,890 ha-1, Rs. 16,485 ha-1 and 1.81 respectively. Similar findings were also reported by Sutagundi, 2000; Bhatt et al., (2011). The Significantly highest values of gross returns, net returns and BCR was observed for the variety PL-4 are Rs. 36,593 ha-1, Rs. 16,153 ha-1 and 1.79, respectively. Similar results were reported by Marwein and Ray, (2019).

4. CONCLUSION

Paddy straw mulch significantly improves the growth and yield parameters of lentil crop in Meghalaya, a region characterized by frequent drought during the winter. Among the different lentil varieties evaluated, PL-4 exhibited the highest yield of 717.5 kg ha-1. Considering the significant soil moisture deficit as a key constraint for crop production, the inclusion of paddy straw mulch in conjunction with the cultivation of lentil variety PL-4 emerges as an effective approach to enhance crop production. These finding help the local farmers to choose the best varity suitable for Meghalaya climatic conditions with emphasis of the usage of straw mulch. However, further research needs be evaluated to determine the long-term viability and scalability across various geographical areas and also to comprehend the wider environmental effects.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

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

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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