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EFFECT OF MULCHING AND INTERCROPPING ON WEED DYNAMICS AND GROWTH PARAMETERS OF LINSEED (*LINUM USITATISSIMUM*) AND LATHYRUS (*LATHYRUS SATIVUS*)

Himadri Saikia*, Rinjumoni Dutta and Sontara Kalita
Department of Agronomy, Assam Agricultural University, Jorhat-785013, Assam, India
*Corresponding author: himadrisaikia195@gmail.com
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ABSTRACT

A field experiment was conducted at Assam Agricultural University, Jorhat, during the *rabi* season of 2021-2022 to assess a suitable linseed and lathyrus intercropping system (s) in rice fallow and to evaluate the effect of paddy straw mulch on growth and yield of linseed and lathyrus intercropping system. The treatments were laid out in a factorial randomized block design with three replications. The experiment consisted of two factors, viz. mulching and cropping systems. There were two levels of mulching viz. no mulching(M_0) and mulching @ 2 tons/ha(M_1) of paddy straw and five levels of cropping systems viz. sole linseed(C_1), sole lathyrus (C_2) linseed: lathyrus 1:1 ratio (C_3), linseed: lathyrus 2:1 ratio (C_4) and linseed: lathyrus 3:1 ratio(C_5).

Results revealed that mulching with paddy straw @ 2 tons per hectare have significantly increased the growth parameters of both linseed and lathyrus. Also, mulching has resulted in a higher gross and net return and benefit cost ratio as compared to no mulch cultivation. Among the cropping systems, the highest growth parameters of linseed were obtained from linseed: lathyrus 1:1 row ratio which was followed by 2:1 and 3:1. Linseed could perform better when intercropped with lathyrus as compared to sole crop. However, the situation was reversed in case of lathyrus as it showed the best performance under sole cropping. The highest gross return, net return and benefit cost ratio was obtained from linseed: lathyrus 1:1 ratio succeeded by 2:1 and 3:1 row ratio.

***Keywords*:** Intercropping, legumes, mulching, oilseed, weed dynamics.

Introduction

Assam is a state where out of the total net sown area of 27.44 lakh hectare, 23.53 lakh hectare area is occupied by rice. Within the bounds of these area, 0.59 lakh hectare area is occupied by autumn rice, 3.77 lakh hectare is occupied by summer rice, whereas the highest area is covered by winter rice i.e., 18.58 lakh hectare (*Statistical handbook of Assam*, 2023-24). To increase the state's overall productivity to the maximum, it is notably important to utilise the winter rice fallow lands of the region. In this aspect, the major concern lies in conserving the soil residual moisture in an economical way which is not only feasible to the farmers but also easily adaptable. With this regard, paddy straw mulching is the most effective way of conserving the soil moisture which also has supplementary benefits like addition of organic matter to the soil and conservation of soil nutrients. Also, utilization of crop residues for such purposes reduces the load of burning the residues, which is one of the rising concerns in today's agricultural system.

On the other hand, intercropping of suitable crops based on economics and complimentary effects, helps farmers reap maximum benefit out of a cropping system. Linseed is one of the major oilseed crops grown in Assam whereas lathyrus is one of the major rabi pulse crop cultivated in Assam, mainly as a relay crop with winter rice. Keeping in mind the importance of these two crops and with the aim of conserving soil moisture, the present experiment was conducted.

Materials and Methods

The experiment was conducted at Assam Agricultural University during the *rabi* season of 2021-22. The experimental site was characterized by sandy loam texture, low pH (5.43) and medium organic carbon (0.63%). The available nitrogen (197.12 kg/ha) was low while the available phosphorus (25.86 P_2O_5 kg/ha) and potassium (180.57 K_2O kg/ha) was in the medium range. The entire experiment was laid out in a factorial randomized block design with 3 replications and two factors *viz.,* mulching and cropping systems. Mulching consisted of two levels – No mulch (M_0) and mulching @ 2 tons per hectare (M_1). Under cropping system, there were 5 levels- sole linseed(C_1), sole lathyrus (C_2), linseed:lathyrus 1:1 row ratio (C_3), linseed:lathyrus 2:1 row ratio (C_4) and linseed:lathyrus 3:1 row ratio (C_5).

The crops were sown on 6th December 2021 and after 115 days lathyrus was harvested. Linseed was harvested 120 days after sowing. The varieties of linseed and lathyrus used in the experiment were "T-397" and "Prateek", respectively.

Ten representative plants (each of linseed and lathyrus) were selected at random in each of the plots and tagged. The numbers of leaves and number of branches were counted and their average was taken for statistical analysis. For crop growth rate (CGR), ten plants from each plot were uprooted randomly and dried in an oven at a temperature of 65 ºC. The average dry weight was calculated and expressed as gram/plant. The different growth parameters were recorded at 30 days interval and formulas used for calculations are given below:

$$\text{Leaf area index (LAI)} = \frac{\text{Leaf area/plant}(cm^2)}{\text{Land area/plant}(cm^2)}$$

$$\text{Crop growth rate (CGR)} = \frac{W_2 - W_1}{(t_2 - t_1)\,S} \quad \text{and}$$

Where,

W_2 and W_1 are plant dry weight (g) at time t_2 and t_1, respectively, and S is land area (m^2) over which dry matter is recorded.

For analysis of weed dynamics, the number of weeds from three randomly selected quadrants of 0.5 m x 0.5m from each plot were counted, multiplied by 4 and average was calculated. The values were expressed as weed population/m^2. The weeds from the selected quadrants from each plot were uprooted, washed properly, oven dried, weighed and multiplied by 4 and average weight of the weeds was calculated.

Results and Discussion

Effect on weed dynamics

Mulching with paddy straw @ 2 tons per hectare had resulted in significant reduction of weed density and weed biomass in comparison to no mulch treatments (Table No. 1 and 2). This had eventually enhanced the growth of both the crops under study. Mulching act as a physical barrier and restricts the amount of light energy reaching the germinating weed seeds. Thus, it can supress the weed growth which has a beneficial impact on the desired crop growth. Organic mulches supress weeds by means of blocking the seed germination initiation caused by the incoming solar radiation, minimizing soil temperature and greatly dampens day-night fluctuations in temperature. Thus, compared to uncovered soil, less weeds can germinate under mulch condition (Schonbeck, 2012). Mulching with rice straw had shown to decrease maximum soil temperature by 2.0-3.3 ^{0}C during emergence of wheat. Compared to no mulch treatment, mulching with varying rates (2, 4, 6 tonnes per hectare) had reduced the mean weed dry matter from 12.5% to 52.7% (Ram *et al.,* 2013). Shafiq *et al.* (2021) also reported that the integration of paddy straw mulch at 6 t/ha with clodinafop plus metribuzin at 195 g/ha post-emergence resulted in the highest tuber yield of potato with weed control efficiency of 95.3% at harvest.

However, the different cropping systems did not exhibit any significant differences in terms of weed biomass and density.

Table 1: Weed biomass per meter square as influenced by mulching and cropping systems

Treatments	Dry matter of weeds per meter square (g/m^2)		
Mulching	**30 DAS**	**60 DAS**	**90 DAS**
No mulch	47.15	56.01	64.46
Mulching	34.39	35.95	55.43
SEm (±)	0.76	1.00	0.57
C.D. (P=0.05)	2.25	2.97	1.69
Cropping systems			
Sole linseed	41.30	46.20	60.99
Sole lathyrus	41.78	46.44	60.33

Linseed:Lathyrus (1:1)	38.77	45.11	59.06
Linseed:Lathyrus (2:1)	40.11	45.28	59.54
Linseed:Lathyrus (3:1)	41.88	46.88	59.82
SEm (±)	1.20	1.58	0.90
C.D. (P=0.05)	NS	NS	60.99
Interaction	NS	NS	60.33

Table 2: Number of weeds per meter square as influenced by mulching and cropping systems

Treatments	**Number of weeds per meter square (number/m^2)**		
Mulching	**30 DAS**	**60 DAS**	**90 DAS**
No mulch	41.21	41.95	59.87
Mulching	35.67	35.00	49.13
SEm (±)	0.67	0.91	0.77
C.D. (P=0.05)	1.98	2.70	2.28
Cropping systems			
Sole linseed	40.17	41.00	56.50
Sole lathyrus	39.50	39.83	54.00
Linseed:Lathyrus (1:1)	37.20	37.03	53.50
Linseed:Lathyrus (2:1)	37.67	37.33	54.50
Linseed:Lathyrus (3:1)	37.67	37.17	54.00
SEm (±)	1.05	1.44	1.21
C.D. (P=0.05)	NS	NS	NS
Interaction	NS	NS	NS

Effect on growth parameters of linseed

The growth parameters of linseed *viz.,* leaf area index, number of branches per plant and crop growth rate, all were significantly higher in mulch treatment as compared to no mulch condition. The possible reason for this enhancement in growth parameters can be attributed to the fact that mulching had efficiently conserved soil moisture and nutrients by preventing their losses via evaporation, volatilization, and leaching. Along with that, mulching had also supressed weed biomass and weed density (as reported in table no. 1 and 2) which had reduced the competition between the weeds and the crops for various resources. As a result, linseed was able to utilize these resources more efficiently. Mulching might have also maintained the soil temperature by acting as an insulating physical barrier and thereby had created congenial environment for the plant growth. The cumulative effect of conserved moisture and nutrients, weed suppression and soil temperature regulation might have resulted into the enhancement of growth parameters in linseed.

The magnification in growth characters of linseed along with increasing levels of straw mulching had also been reported by Singh and his co-workers (2014) wherein they concluded that paddy straw mulching had resulted in higher plant height and number of branches per plant over no mulching. Priya *et al.* (2018) also reported that mulching in both *Kharif* and *Rabi* season had recorded the highest plant height, number of branches, leaf area index, number of pods, test weight and grain yield of chickpea.

The different intercropping systems also did affect the growth characters of linseed including leaf area index, number of branches per plant, crop growth rate and relative growth rate. All the growth parameters were found to be highest in linseed:lathyrus 1:1 ratio followed by 2:1 and 3:1 row ratio. The crop growth rate was also highest in 1:1 row ratio till 90 days after sowing. The lowest growth parameters were recorded from sole linseed. The probable reason for this improvement in growth parameters of linseed upon intercropping with lathyrus over sole cropping might be because of lathyrus, which is a legume crop that could meet its nitrogen requirement by fixing atmospheric nitrogen and thus, can render more amount of soil nitrogen to be consumed by linseed.

Further, the advantages gained by linseed when it was intercropped with lathyrus might also be because of spatial differences between the two crops. As compared to lathyrus, linseed is much taller and thus, it could intercept lighter when grown in association with lathyrus. Whereas in sole linseed, since all the plants were approximately of the same height it might had hindered the process of light interception by shading effect. Thus, it can be concluded that higher the proportion of legume i.e., lathyrus in the intercropping system better was the performance of linseed which can be clearly seen from the findings of the present experiment.

Table 3: Leaf area index, number of branches per plant and crop growth rate of linseed at different growth stages

Treatments	Leaf area index			No. of branches/plant		Crop Growth rate (g/m^2/day)			
Mulching	30 DAS	60 DAS	90 DAS	60 DAS	90 DAS	0-30 DAS	30-60 DAS	60-90 DAS	90-120 DAS
No mulch	0.160	0.859	1.486	3.92	4.84	0.078	1.048	1.138	0.730
Mulching	0.183	1.451	1.767	4.26	5.27	0.095	1.204	1.462	1.446
SEm (±)	0.005	0.030	0.044	0.10	0.14	0.001	0.017	0.050	0.039
C.D. (P=0.05)	0.015	0.091	0.133	0.31	0.42	0.004	0.05	0.151	0.117
Cropping systems									
Sole linseed	0.161	1.018	1.426	3.46	4.50	0.065	0.841	1.014	1.033
Linseed:Lathyrus (1:1)	0.179	1.331	1.883	4.63	5.79	0.109	1.366	1.558	1.185
Linseed:Lathyrus (2:1)	0.172	1.186	1.666	4.18	5.13	0.095	1.212	1.358	1.102
Linseed:Lathyrus (3:1)	0.174	1.086	1.530	4.08	4.79	0.075	1.084	1.271	1.033
SEm (±)	0.007	0.043	0.062	0.14	0.20	0.001	0.024	0.070	0.055
C.D. (P=0.05)	NS	0.129	0.188	0.43	0.60	0.005	0.074	0.214	NS
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS

Effect on growth parameter of lathyrus

Analogous to linseed, the different growth parameters of lathyrus like leaf area index, number of branches and crop growth rate had also increased significantly upon application of paddy straw mulch. The reason behind such an enhancement in growth characters of lathyrus might be same as cited above in case of linseed that mulching conserved the residual soil moisture and nutrients better along with maintaining the soil temperature and suppressing weed density and biomass. All these factors combined had cause increment in growth characters of lathyrus. Bunna *et al*. (2011) reported that mulching with rice straw at the rate 1.5 t/ha had enhanced the crop establishment of mungbean from 72 to 83%, caused reduction in weed biomass from 164 to 123 kg/ha and increased yield from 228 to 332 kg/ha.

Among the cropping systems, lathyrus had been found to perform best under sole cropping as compared to intercropping with linseed. The growth parameters including leaf area index, number of branches, crop growth rate and relative growth rate were significantly highest in sole lathyrus and lowest in linseed:lathyrus 3:1 ratio.

The proposed justification for these results is that in intercropping of linseed and lathyrus, linseed had proved to be the dominant crop with positive aggressivity values of 0.16, 0.47, 0.62 in 1:1, 2:1 and 3:1 linseed:lathyrus row ratio, respectively. Lathyrus was dominated by linseed as indicated by its corresponding negative aggressivity values. Thus, lathyrus suffered severe competition for different resources upon intercropping with linseed and produced lower growth parameters than sole cropping. Singh *et al*. (2021) also reported that among intercropping systems of Indian mustard + chickpea, Indian mustard + lentil, linseed + chickpea and linseed + lentil, Indian mustard (*Brassica juncea*) and linseed *(Linum usitatissimum*) were dominant and aggressive.

Table 4: Leaf area index, number of branches per plant and crop growth rate of lathyrus at different growth stages

Treatments	Leaf area index			No. of branches/plant		Crop growth rate (g/m^2/day)			
Mulching	30 DAS	60 DAS	90 DAS	60 DAS	90 DAS	0-30	30-60	60-90	90-115
No mulch	0.280	0.880	1.387	3.53	4.33	0.230	0.735	0.699	0.573
Mulching	0.302	0.902	1.448	4.15	4.92	0.290	0.749	0.756	0.654
SEm (±)	0.007	0.007	0.009	0.10	0.12	0.005	0.004	0.010	0.018
C.D. (P=0.05)	0.021	0.021	0.026	0.31	0.37	0.016	0.013	0.030	0.054
Cropping systems									
Sole lathyrus	0.320	0.920	1.451	4.57	5.25	0.286	0.779	0.817	0.700
Linseed:Lathyrus (1:1)	0.297	0.897	1.413	3.95	4.75	0.275	0.737	0.784	0.616
Linseed:Lathyrus (2:1)	0.278	0.878	1.403	3.53	4.42	0.263	0.729	0.684	0.601
Linseed:Lathyrus (3:1)	0.270	0.870	1.400	3.32	4.08	0.217	0.724	0.624	0.536
SEm (±)	0.010	0.010	0.012	0.14	0.17	0.007	0.006	0.014	0.025
C.D. (P=0.05)	0.030	0.030	0.037	0.44	0.52	0.022	0.019	0.042	0.076
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS

Effect on overall yields of the systems

Mulching @ 2 tons per hectare had significantly increased the yields of both linseed and lathyrus over no mulch condition. This might be the result of enhanced growth characters of the crops which had eventually improved the yield attributing characters and finally the yields. As mentioned earlier along with amplification of growth characters Singh *et al.* (2014) also reported that seed yield, stover yield and oil content of linseed were increased upon application of paddy straw mulching. Devedee *et al.* (2017) also found that mulching in linseed had resulted in significant increase in capsule number, number of seeds per capsule, seed yield and straw yield along with biological yield. Priya *et al.* (2018) also reported that the number of pods, test weight and grain yield of chickpea were considerably increased under mulching over no mulching.

The comparison among the cropping systems was based on linseed equivalent yield. All the cropping systems differed significantly in terms of linseed equivalent yield with highest linseed equivalent yield in linseed:lathyrus 1:1 ratio (556.52 kg/ha). Linseed:lathyrus 2:1 and 3:1 ratio gave 530.73 kg/ha and 522.15 kg/ha linseed equivalent yield, respectively, which were statistically at par. Sole linseed gave significantly the lowest linseed equivalent yield of 499.03 kg/ha than all the intercropping systems. Sole lathyrus produced a yield of 479.10 kg/ha. This was because, linseed had performed better when it was intercropped with lathyrus as compared to sole crop which eventually resulted in higher linseed equivalent yields in intercropping systems. Among the intercropping systems, since linseed:lathyrus 1:1 ratio performed the best in terms of growth and yield parameters of both linseed and lathyrus, therefore it had finally given the highest linseed equivalent yield with highest net return, gross return and B-C ratio. Padhi *et al.* (2006) also concluded that maize grain equivalent yield (37.5 q/ha) was significantly higher in maize + black gram in 1:1 row ratio over 2:2 and 2:1.

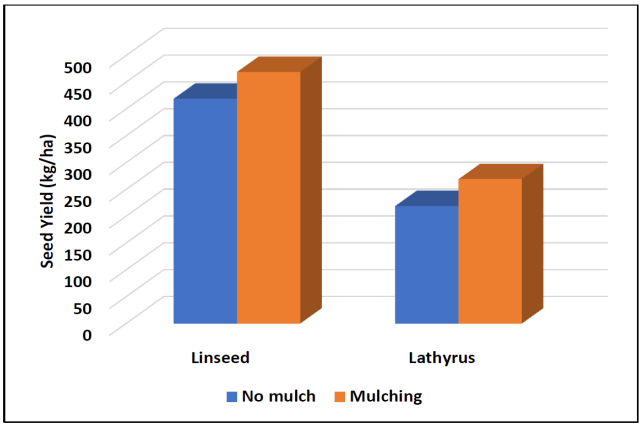

Fig. 1: Effect of mulching on seed yield

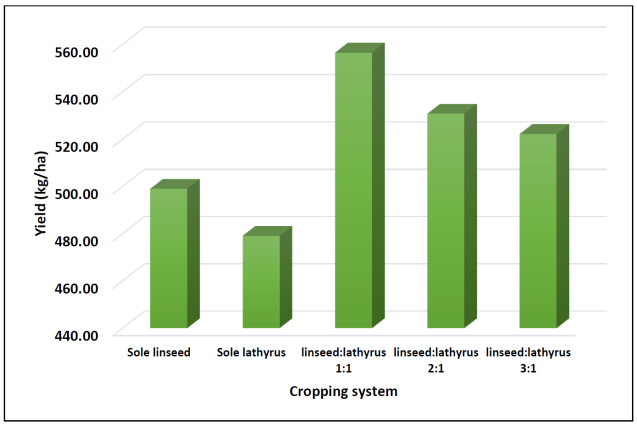

Fig. 2: Linseed equivalent yield of the cropping systems

Conclusion

Mulching with paddy straw @ 2 tons/ha had shown improvement in growth parameters of both linseed and lathyrus over no mulch condition. Intercropping of linseed with lathyrus had also been found beneficial with respect to linseed growth characters. Although, the growth of lathyrus was reduced when intercropped with linseed, the increased growth of linseed could compensate for this loss which was reflected by the equivalent yield of the cropping system and the relative crowding coefficient values of more than 1 in all the intercropping systems. Thus, paddy straw mulch in integration with intercropping of oilseed with legume can be a suitable and advantageous practice in the medium rice fallow lands of Assam to increase the yields and overall productivity of the region. However, these findings are based on one year experiment and therefore they certainly need to be evaluated further.

References

Anonymous. (2023). Statistical Handbook Assam. *Directorate of Economics and Statistics.* Government of Assam, Guwahati.

Bunna, S., Sinath, P., Makara, O., Mitchell, J. and Fukai, S. (2011). Effects of straw mulch on mungbean yield in rice fields with strongly compacted soils. *Field Crops Research*. **124**(3), 295-301.

Devedee, A.K., Singh, R.K., Singh, H. and Kumar, V. (2017). Effect of Mulching, Cumulative Pan Evaporation Ratio and Nutrient Levels on Yield, Nutrient Content and Uptake of Linseed. *International Journal of Plant & Soil Science*. **20**(3), 1-7

Padhi, A.K. and Panigrahi, R.K. (2006). Effect of intercrop and crop geometry on productivity, economics, energetics and soil-fertility status of maize (*Zea mays*)-based intercropping systems. *Indian journal of Agronomy*. **51**(3), 174-177.

Priya, H.R., Shashidhara, G.B. and Kumara, B.H. (2018). Performance of chickpea as influenced by mulching practices in maize-chickpea cropping system. *Journal of Pharmacognosy and Phytochemistry*. **SP1**, 1361-1365

Ram, H., Dadhwal, V., Vashist, K. K. and Kaur, H. (2013). Grain yield and water use efficiency of wheat (*Triticum aestivum* L.) in relation to irrigation levels and rice straw mulching in North West India. *Agricultural Water Management*. **128**, 92-101.

Schonbeck, M. (2012). Organic mulching materials for weed management. *Organic Agriculture. Virginia. Association for Biological Farming*. United States of America.

Shafiq, M., & Kaur, S. (2021). Weed control using paddy straw mulch in integration with herbicides in autumn potato in North-West India. *Potato research*. **64**(4), 761-773.

Singh, N.A., Sorokhaibam, S., Yumnam, S. and Konsam, J. (2021). Enhancing pulse productivity under rice-based production system through chickpea and lentil based intercropping systems in North East India. *Legume Research, An International Journal*. **44**(2), 215-220.

Singh, R.K., Singh, A. and Singh, K. (2014). Effect of moisture conservation practices on linseed (*Linum usitatissimum* L.) under rainfed conditions. *Environment and Ecology*. **32**(2), 425-427.