Progress Report 2013-14
OCPF-ICARDA Food Legume Initiative

on

"Increasing the food legumes production by small farmers to strengthen the food and nutritional security through adoption of improved technologies and governance within South-South cooperation"

Submitted to

International Center for Agricultural Research in the Dry Areas (ICARDA)
South Asia & China Regional Program (SACRP), New Delhi

Submitted by

ICAR Research Complex for NEH Region, Tripura Centre, Lembucherra-799210, Tripura

Name of the Project: Increasing the food legumes production by small farmers to strengthen the food and nutritional security through adoption of improved technologies and governance within South-South cooperation

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State: Tripura

District: Dhalai Tripura, South Tripura, West Tripura and Khowai Tripura

Crop (s): Lentil

No. of villages: 19

No. of farmers: 242

Area covered: 63 ha

Crop Season: *Rabi*

Introduction and background

All over India the Gomukh is an auspicious emblem. Ancient drinking fountains and clear springs are often directed to flow through spouts fashioned in the form of a cow's head. Tripura is the gomukh of the north-east. It thrusts out into Bangladesh with only its neck attached to Mizoram and Assam. Tripura is one of the seven states in the north eastern part of India located between 22 degree and 56 minutes and 24 degree and 32 minutes north latitude and between 90 degree and 09 minutes and 92 degree and 20 minutes east latitude. It is bounded on the north, west, south and south-east by Bangladesh whereas in the east it has a common boundary with Assam and Mizoram. Tripura is a hilly and landlocked state endowed with vast green forests and established gas reserves. The state has a total area of 10492 sq. km. The state has a long border with Bangladesh of 856 km. whole Tripura is divided in eight districts ((Map of Tripura). As in the other states of the north east, Tripura's economy is primarily agrarian and agriculture and its allied activities contribute nearly 34 % to the state's Net Domestic Product (Map 1).

Map of Tripura

Rainfall is the primary determinant of crop production in Tripura. However, rainfall is highly variable in terms of length of the rainy season and amount of rainfall. This variability had a significant impact on rainfed agriculture in the state. Rainfed lowland rice ecosystems are highly variable and unpredictable in nature (Yoshida 1977). Multiple abiotic stresses such as unfavourable soil conditions, regional weather patterns, topography, pests and weeds all contribute to the complexity of the ecosystem. The income of most farmers is low and they are challenged by erratic yields. The average of rainfall over a long period of time is showing that the amount of rainfall is sufficient for growing of at least two crops in a season. There is sufficient amount of rainfall starts from April (172.3 mm) to October (186 mm) is depicted in fig no. 1. Normal distribution of rainfall of Tripura showed that the approximately ±200 mm rainfall received from April to October in each month. This rainfall pattern provides sufficient residual soil moisture for growing lentil in rice fallow after harvest of rice. Land use pattern show a unique trend in Tripura (Table 1).

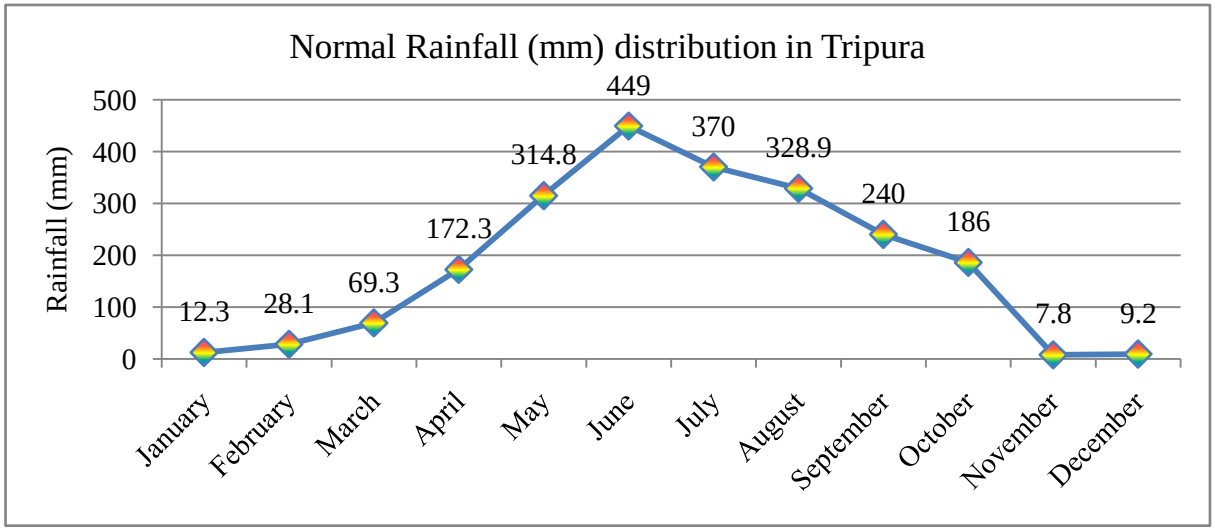


Fig 1 Normal rainfall distribution in Tripura

Table 1 Land use pattern in Tripura

i)	Total geographical area	10,43,169 ha.
ii)	Net area sown	2, 55,524 ha.
iii)	Forest area	6.29,429 ha.
iv)	Area sown more than once	1, 92,968 ha.
v)	Gross area sown	4, 48,492 ha.
vi)	Cropping intensity	176%

The agricultural sector is the largest contributor to the economy of Tripura state. Besides striving to meet the food requirement, the sector has a strong impact on the needs and overall quality of life of the people of Tripura. More than 75% of the state's total workforce is still dependent on agriculture for their subsistence. The ICAR and state departments have been trying to alleviate farmers' problems through introduction of new technologies, fertilizers, improved seeds and protective chemicals since their inception in Tripura. The agricultural production and productivity depends largely on the quality of land and sustainable practices. A balance between efficient and productive agricultural enterprise and environmental protection and sustainability is important to make agriculture sector an economically viable venture. In the recent decade, the achievement of self-sufficiency in food production in various states was accorded high priority in the food policies of the country. Tripura, one among the north eastern states of India is also successful in achieving self-sufficiency in various sectors by increasing its food production in manifolds. But it has not yet solved the problem of chronic food security at the household level and year to year fluctuations in food production. The state is showing the self sufficiency only in rice production, those constituents the more than 90% of total food grain production. However the status pulse production is very poor. The share of total pulse production including the oil seed production was less than 1% (Figure 2). The agricultural production of the state is not in the pace with population growth at 14.75 per cent per decade. Now the state showed the significant shortage in pulses production is because of traditional farming or due to non-adaptation of recommended technologies. To find out the answers of these questions ICAR Tripura Centre in collaboration with ICARDA was started the demonstration of improved varieties of lentil with improved production technology in rice fallow land of Tripura.

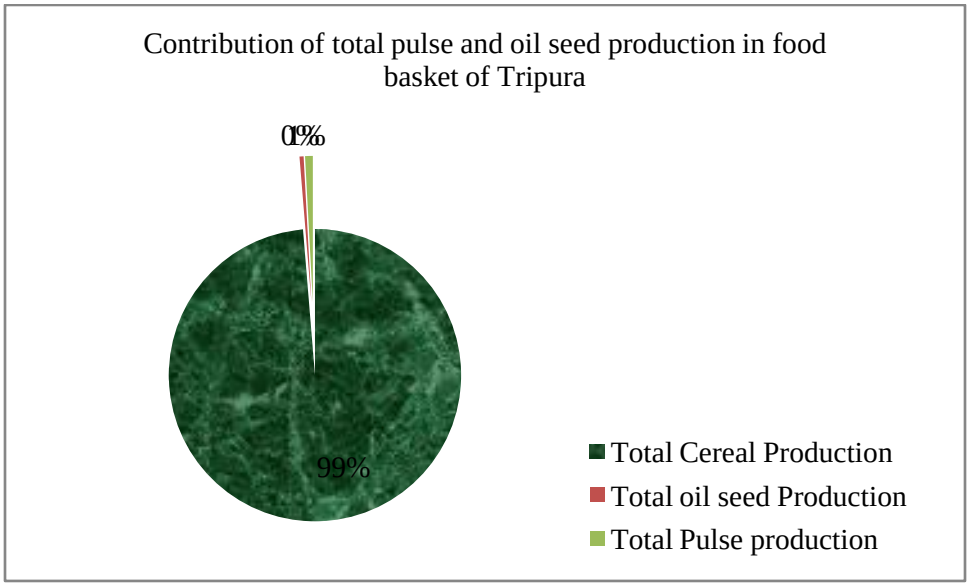


Figure 2 Contribution of pulses production in Total food grain production in Tripura

Lentil (*Lens culinaris* Medikus Subsp *culinaris*) is one of the major *rabi* pulse grown in India since time immemorial. It contributes significantly to food, feed and sustainable farming systems and contains high amount of digestible protein (upto 35%), macro- and micronutrients, particularly Iron and Zinc and Vitamins, thus providing nutritional security to consumers. Lentil straw is a valuable animal feed as it has high digestibility, protein, Calcium and Phosphorous compared to wheat straw and is highly palatable as well. Its cultivation improves soil health by adding nitrogen, carbon and organic matter, thus provides sustainability to the cereal-based cropping systems. Lentil occupies 13.8 lakh hectares of area with the total production of 9.5 lakh tons. The crop can be grown on a variety of soils (light loams, alluvial and black cotton soils) and is mostly cultivated under rainfed condition. In the last three decades, the area of Lentil has increased by 85% and production by 151%, however the productivity has increased only by 34%. There are Major Gaps in Lentil productivity enhancement that are:

- Negligible seed replacement with high yielding suitable variety
- Improper dissemination of improved production technologies including integrated pest and nutrient management
- Non-availability of quality seed
- Unawareness about lentil in some area like Tripura

This shows tremendous scope for increasing the productivity of the pulse by overcoming these major gaps in productivity enhancement.

Lentil is grown as a post-rainy season crop mostly under rainfed farming. Lentil is grown on very little area in Tripura. Most of the farmers are unaware about the cultivation of lentil. But lentil has Substantial scope in Tripura. Tripura is rice dominating state, which cover almost 90% area. Although after harvest of rice field remain fallow till the next rice season. Hence lentil can be grown in rice fallow as relay crop/paira crop or under conservation tillage. The cultivation of lentil may enhance the farmer's income as well as soil health. That may also benefit the succeeding rice crop.

Major Activities

- Selection of villages and farmers
- Supply of inputs and demonstrating the technology with two selected varieties
- Farmer's field day

Target Areas

Target district	**Components promoted**
Dhalai Tripura	➢ Improved varieties and technological interventions (package of practices) ➢ Minimum/zero tillage/conventional tillage practices ➢ Para cropping
West Tripura	

South Tripura	➢ Seed treatment & seed priming ➢ Nutrient management ➢ Integrated management of diseases Capacity building ➢ Weed management ➢ Population management
Khowai Tripura	

Target District, Villages and Area Coverage

Enhancing Lentil Production rice fallow was started by ICAR Tripura centre in collaboration with ICARDA in 2012-13". A total of 4 districts of Tripura were covered with a number of total 19 villages. New improved high yielding lentil varieties were introduced to a total of 242 farmers in covering an area of 63 ha in 2013 – 14. The names of villages involved in the project are given below:

S.N.	Name of district	Name of village	No. of farmers	Area covered (ha)
1.	Dhalai	Moracherra	17	4
		Balram	10	3
		Kankacherra	13	5.2
		Kamalacherra	20	8.4
2.	South Tripura	Sabroom	31	10
		West pilka	19	4
		Ramrai	5	2
		Nalua	9	2
		Sukantanagar	5	1
		Lakhicherra	5	1
		Garji	3	0.5
		Rishimukh	20	5
3.	West Tripura	Abhicharan choudhurypara	12	1.75
		Berkhthal	12	2.5
		Nabchandrathakur para	10	2.5
		Fatikcherra	13	3.25
		Purnathakurpara	19	3.25
		Nepali basti	1	0.16
4	Khowai Tripura	Khashia mangal	18	3.25
Total			242	62.76

Technological Interventions

Technological interventions were provided to the farmers on lentil cultivation. According to the phonological stages of the crop, the details of these interventions are given below-

Improved crop varieties

1. HUL-57
2. NDL-1
3. WBL-58
4. WBL-77
5. PL-06

Lentil farmers

Lentil seed distribution

Method of establishment

1. Para cropping
2. Reduce tillage cultivation
3. Zero tillage cultivation

Reduced tillage lentil

Zero tillage lentil

The performance of reduced tillage lentil is better than the crop grown under zero tillage condition

Seed rate- 30-35 kg/ha for conventional and reduced tillage, 40-45 kg/ha for zero tillage and 50-60 kg/ha for paira cultivation

Seed treatment- Seed treatment with insecticide, fungicide and rhizobium culture. Seed was treated with Rhizobium culture @ of 5 packets/ha. It was also treated with Bavistin@ 2 g /kg.

Seed priming- Seed priming was

Performed for better germination

Seeds were soaked during night for

12 hours with natural water,

Seed treatment

drained out excess water and dried

in shade before sowing.

Sowing

Line sowing-Sowing at the distance of 25-30 cm was done.

Broad casting- Seed was broadcasted after one ploughing and the second ploughing was done to mix the seed in the soil.

Sowing time- we took the four (4) different times for sowing to see the performance of time on sowing on productivity.

i. 1st fortnight of November
ii. 2nd fortnight of November
iii. 1st fortnight of December
iv. 2nd fortnight of December

			
1st fortnight of November	2nd fortnight of November	1st fortnight of December	2nd fortnight of December

Weed management- Pendimethalin P.E. @ 1.5 kg a.i/ha was applied immediately after sowing was done to avoid losses due to weeds.

Nutrient management – 20 kg N, 40 kg P_2O_5 and 20 Kg K_2O/ha was applied in the form of urea, SSP and MOP respectively.

Urea spray- Foliar spray of 2% Urea along with Boron and Zinc will be done just before flowering and repeated after 10-15 days specially to avoid the moisture and atmospheric stress.

Activities and Achievements

Performance of lentil at Dhalai Tripura

Three Lentil varieties namely WBL-77, PL-06 and WBL -58 were distributed among the 60 farmers. The crop was grown on 20.6 ha of total land at Dhalai Tripura for demonstration of improved lentil production technologies in rice fallow area after harvest of rice, with the objective to enhance lentil production and nutritional security. WBL-77 was sown in the month of November under reduced tillage condition showed the better performance. PL-06 was sown in

second fortnight of November and WBL-58 was sown in the month of December. Both the varieties should they showed the very good germination. Lentil variety WBL-77 produced higher seed yield as compared to WBL 58 and PL-06. There WBL 77 is most suitable for cultivation in Dhalai (Figure 3).

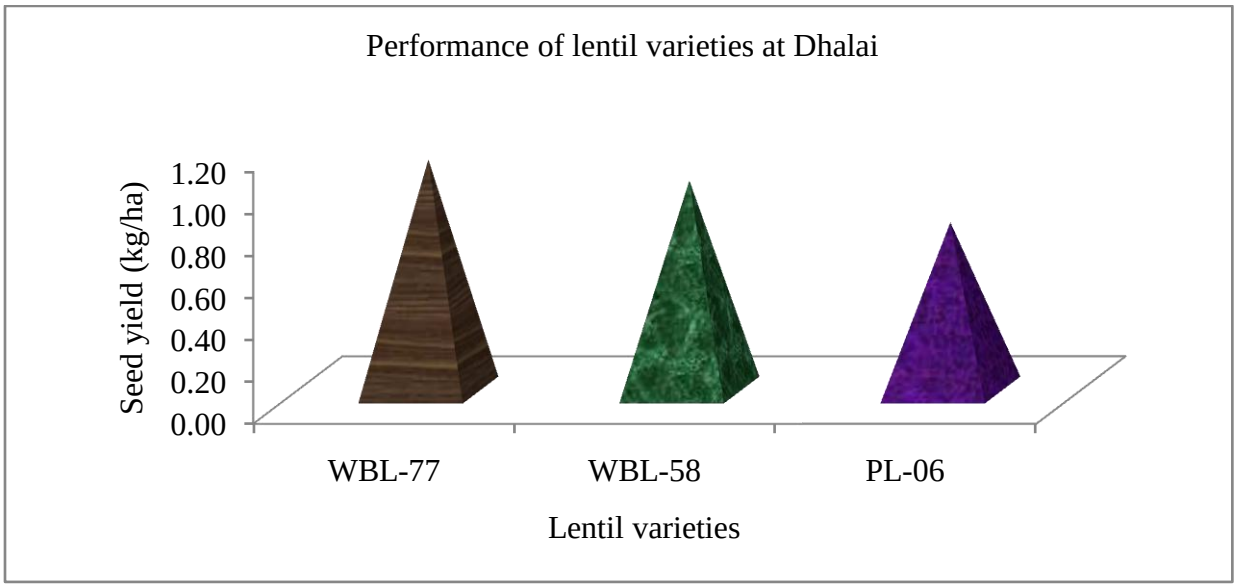


Figure 3 Performance of lentil varieties at Dhalai Tripura

WBL – 77 lentil variety under reduced tillage cultivation

Performance of lentil at West Tripura

Five Lentil varieties namely PL-06, NDL-1, WBL – 77, WBL-58 and HUL-57 were distributed among the 67 farmers. The crop was grown on 17 ha of total land at West Tripura for

demonstration of improved lentil production technologies in rice fallow area after harvest of rice, with the objective to enhance lentil production and nutritional security. Lentil in West Tripura was sown under different date sowing with different methods of establishment and sowing as followed:

Effect of date of sowing of seed yield of lentil

Lentil variety HUL-57 was sown on different dates viz. 5th, 10th, 15th, 20th, 25th November and 5th, 10th December respectively. The estimated seed yield shown that the optimum time for sowing lentil crop was from 15th to 20th November which gave highest yield among all date of sowing and the crop sown on 10th December recorded lowest yield (Figure 3).

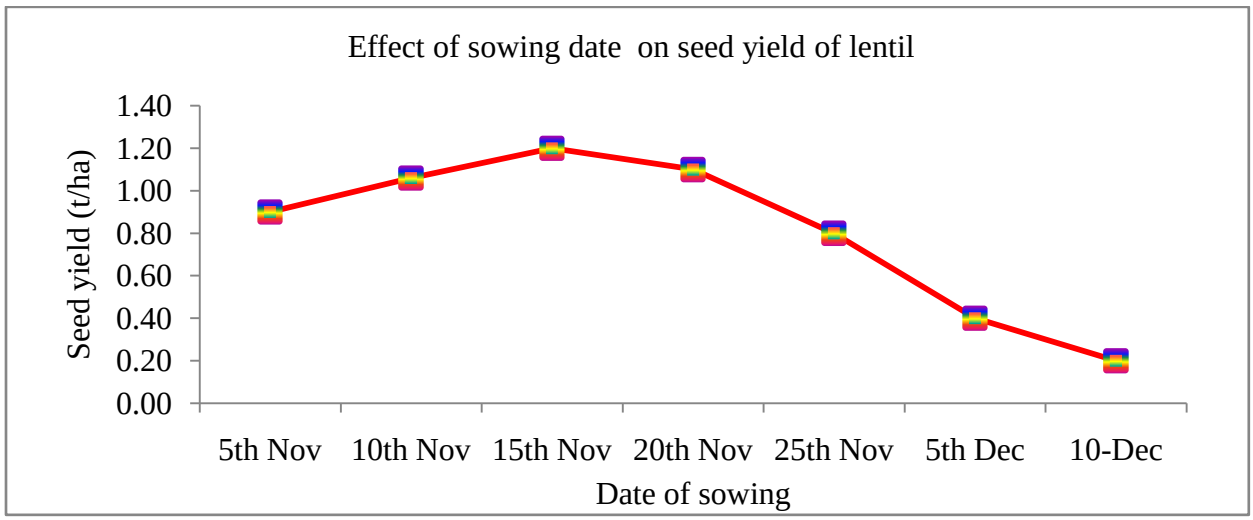


Figure 3 Effect of sowing date on lentil seed yield

Effect of methods of establishment on lentil seed yield

Lentil was sown under different methods of establishments viz. reduced tillage, Zero tillage and Paira cropping. The Lentil varieties grown under reduced tillage recorded the highest yield however, paira cultivation of lentil produced lowest seed yield (Figure 5).

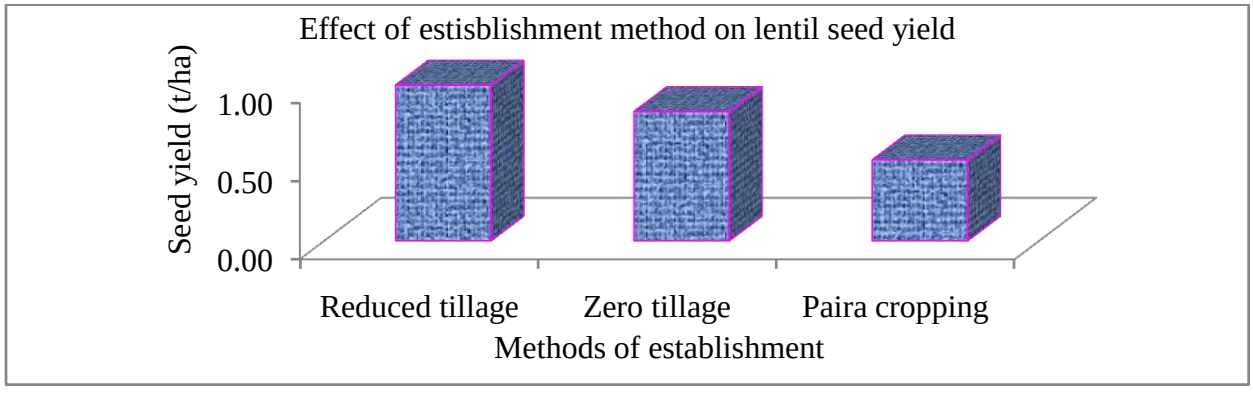


Figure 5 Effect of methods of establishment on seed yield of lentil

Effect of method of sowing on lentil yield

The five Lentil varieties namely PL-06, NDL-1, WB –77, WBL-58 and HUL-57 were sown through line sowing and broadcasting. Among the line and broadcasting methods of sowing, the line was found much better for cultivation of lentil and produced more seed yield as compared to broadcasting (Figure 6).

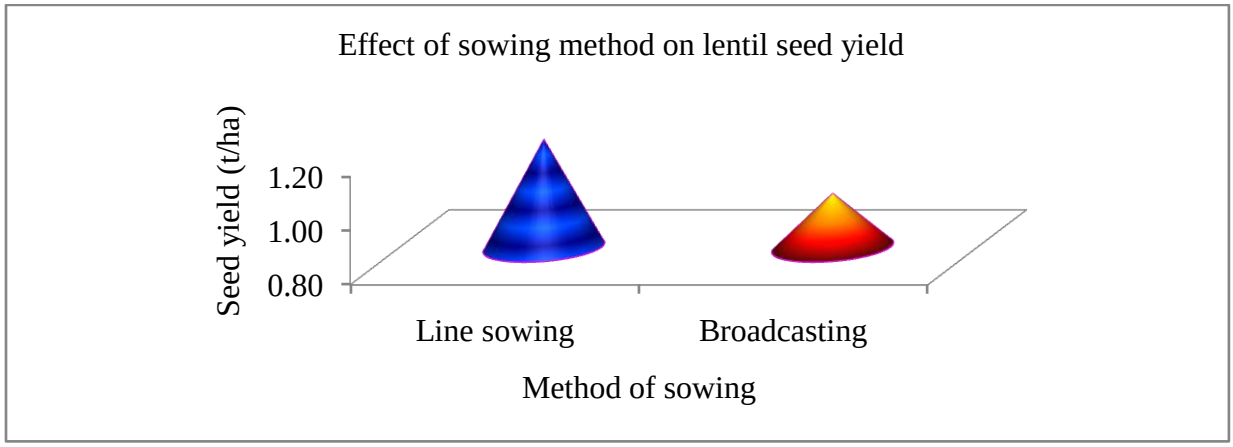


Figure 6 Effect of method of sowing on lentil yield

Performance of lentil varieties

Among the five varieties of Lentil viz. PL-06, NDL-1, WB –77, WBL-58 and HUL-57 under study, the variety HUL-57 produced the highest seed yield. The seed yield of varieties PL-06 and NDL-1 was at par and lowest yield among the varieties, similarly the seed yield of varieties WBL-77 and WBL-58 was also at par (Figure 7).

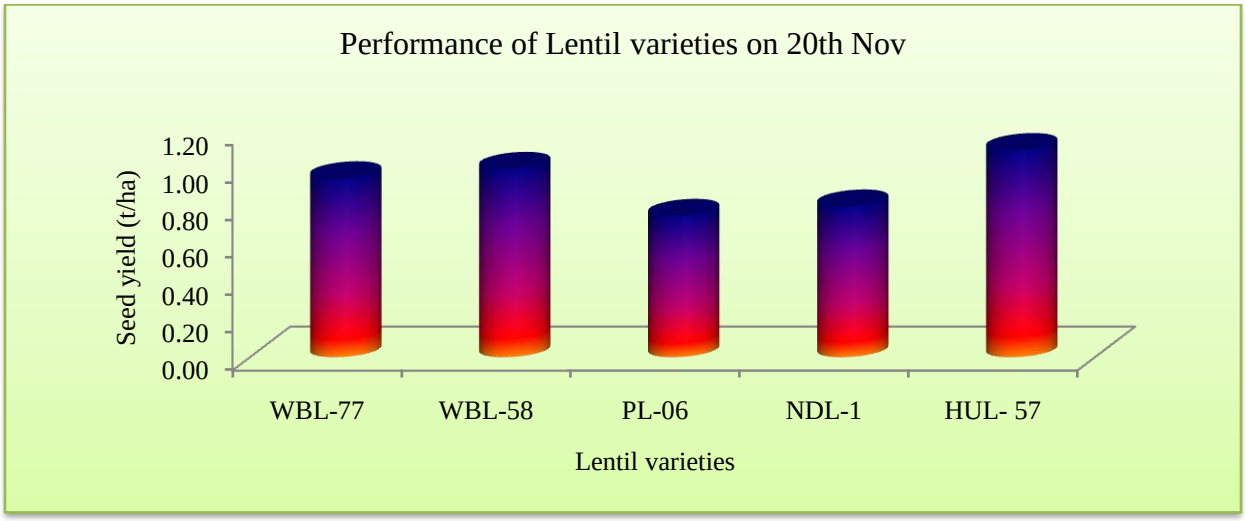


Figure 7 Yield performances of lentil varieties

WBL-58 in zero tillage at farmer's field

HUL-57 in reduced tillage at farmer's field

Performance of lentil at South Tripura

The four varieties of lentil seed (WBL-58, PL-06, HUL-57 and NDL-01) were distributed among the 77 farmers. The crop was grown on 21 ha of total land at South Tripura for demonstration of improved lentil production technologies in rice fallow area after harvest of rice, with the objective to enhance lentil production and nutritional security. The crop was sown from second fortnight of November to December with recommended package of practices under both the zero tillage as well as conventional tillage. The performance of crop was good in farmer field some photographs of crop are given below and the farmers showed very good interested in cultivation of lentil in rice fallow after harvest of rice. Among the lentil varieties HUL – 57 was recorded highest yield followed by NDL-01, PL-06 and WBL – 58 (Figure 8). In West Pilak area NDL -1 was tried in minimum tillage condition. Yield obtained under minimum tillage condition was 6.2 q/ha.

Average yield data of different lentil varieties at South Tripura

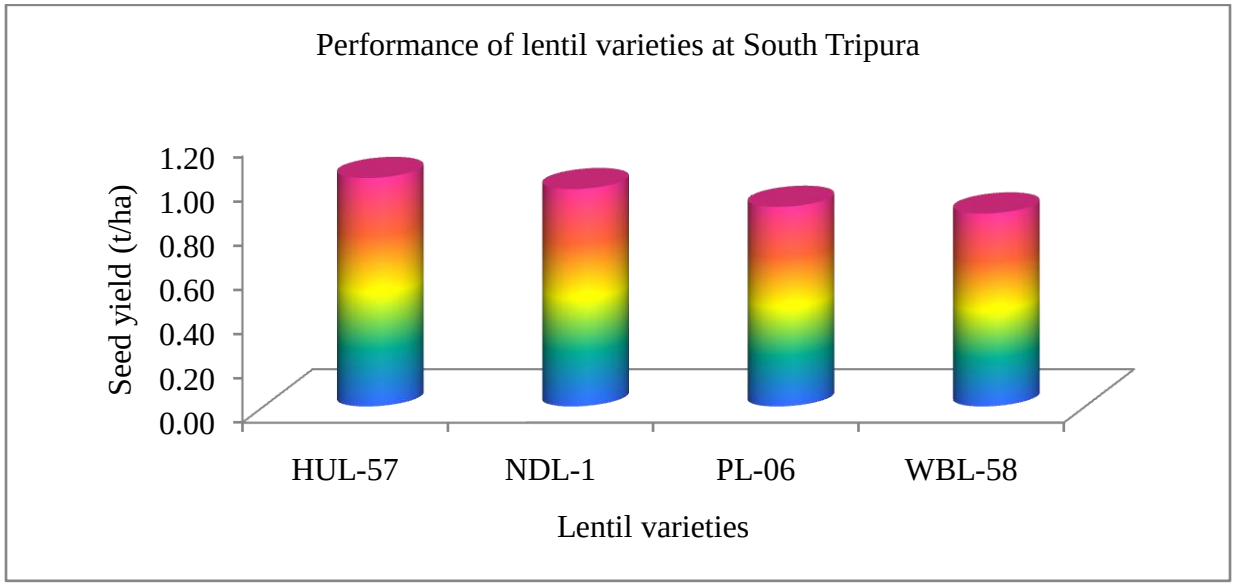


Figure 8 Average yield data of different lentil varieties at South Tripura

HUL -57

Farmer's participatory varietal selection

Two trials was start to evaluated most suitable lentil variety for Tripura condition as follows:

1. On farm agronomic performance of lentil varieties distributed to farmers for demonstration

Five lentil varieties HUL-57, PL-06, NDL-1, WBL-58 and WBL-77 were distributed to farmers for demonstration was also sown on experimental farm to see the performance of all the varieties. The crop was sown on 5th December 2013 under randomized block design with three replication. Lentil variety NDL-1 produced maximum number of branches/plant, number of

pod/plant and seed yield followed by WBL-58 and HUL-57 than PL-06 and WBL-77. However, HUL-57 produced maximum number of seed/pod and PL-06 recorded highest 1000 seed weight (Table 1). Some photographs showing the growth performance are given bellow.

Table 1 yield attributes and seed yield of different lentil varieties

Treatment	Branch/Plant	Pod/Plant	Seed/Pod	1000 seed Weight (g)	Seed yield (kg/ha)
PL-06	8	50	1.8	35.7	814.5
NDL-1	10	68	1.6	29.0	1339.5
HUL-57	9	56	2.0	17.3	1009.1
WBL-77	8	51	1.8	20.0	894.8
WBL-58	10	57	1.8	21.0	1137.8
SE±	0.3	3.5	0.1	0.7	57.9
CD	1.1	11.3	NS	2.3	188.8

2. Evaluation of newly introduced lentil varieties/lines at ICAR farm

Twenty three lentil varieties/lines were shown under farmers participatory varietal selection programme. The crop was sown in 22 November 2013 and randomized block design. The all varieties were replicated twice. All the lentil varieties had shown different trend in flowering and maturity. The days to 50% flowering and days to 50% pod maturity varies from 52-67 days after sowing (DAS) and 85-99 DAS, respectively. The variety L-112-7 was require minimum days after sowing for 50% flowering and pod maturity. However, variety ILL-10971 need maximum days for 50% flowering and pod maturity (Table 2). Lentil root length and root nodule were recorded at flowering and pod initiation stage. The lentil variety RL-12-171 was recorded significantly highest root length and root nodule/plant followed by L-112-7 and ILL-10951 as compared to all other lentil varieties (Figure 9 & 10). The both root length and root nodule showed a significant linear relationship with seed yield (Figure 11 &12). Yield attributes and yield of lentil was significantly varies among the different lentil varieties. The variety ILL10951 produced maximum number of branches/plant. However, variety L-118.7 was produced maximum number of pods/plant and has highest pod weight. Seed/pod was higher in WBL-81 and ILL-8180 had shown highest test weight (Table 3). The lentil variety RL-12-171 was recorded significantly highest seed yield/ha followed by L-112-7 and ILL-10951 as compared to all other lentil varieties (Table 3). Some photographs showing the growth performance are given bellow.


RL-12-171
27 12 2013


L-1127
27 12 2013


ILL-10897
27 12 2013


ILK-108
27 12 2013


ILL-10897
27 12 2013

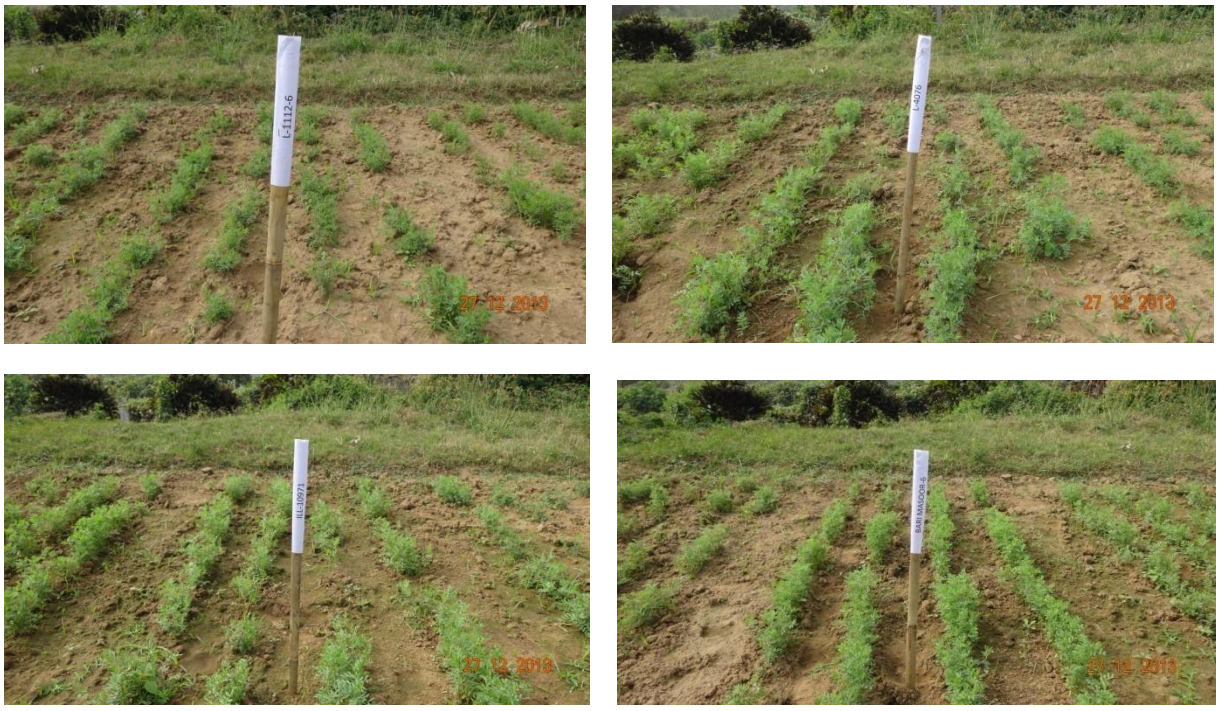

ILK-108
27 12 2013


BARI MASOOR-7
27 12 2013


L-112-14
27 12 2013


BARI MASOOR-5
27 12 2013


ILL-237
27 12 2013



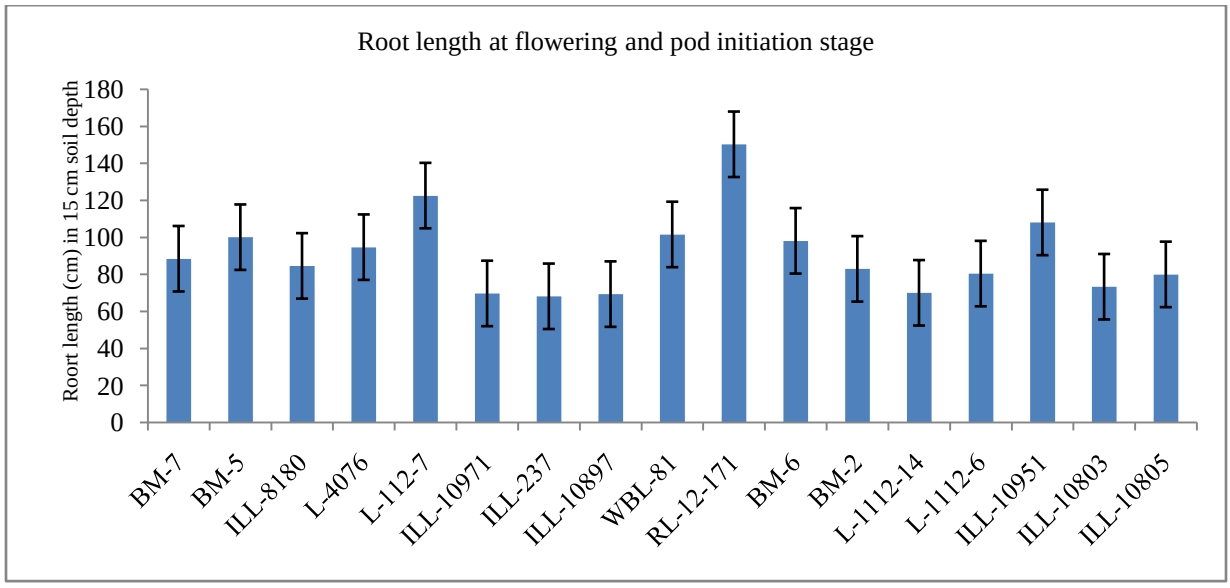


Figure 9 Root lengths of different lentil varieties

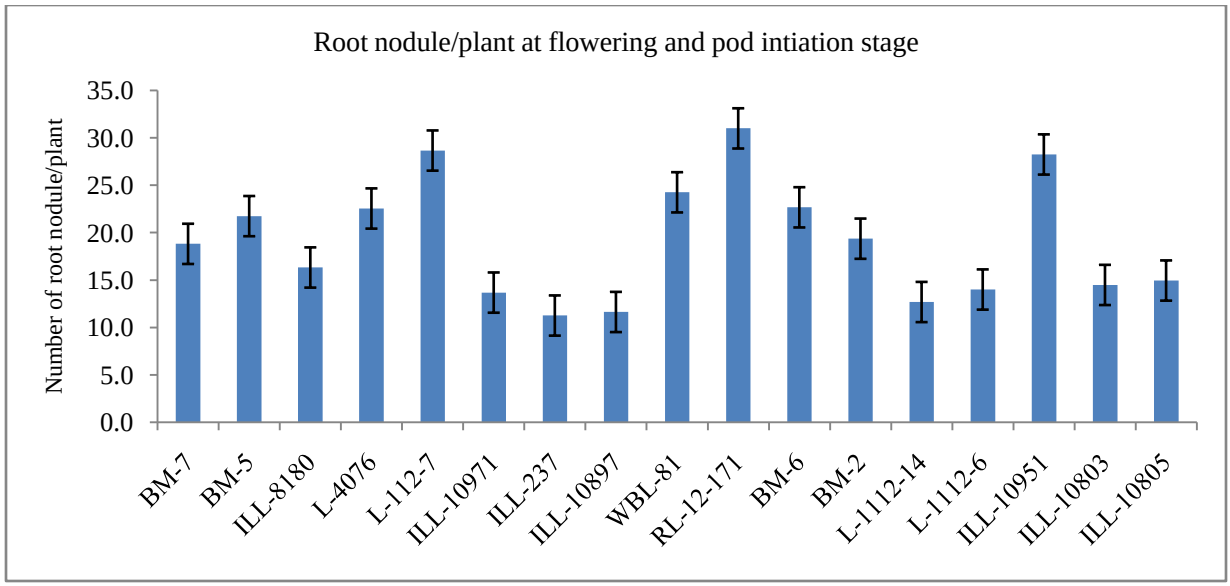


Figure 10 Root nodule producing potential of different lentil varieties

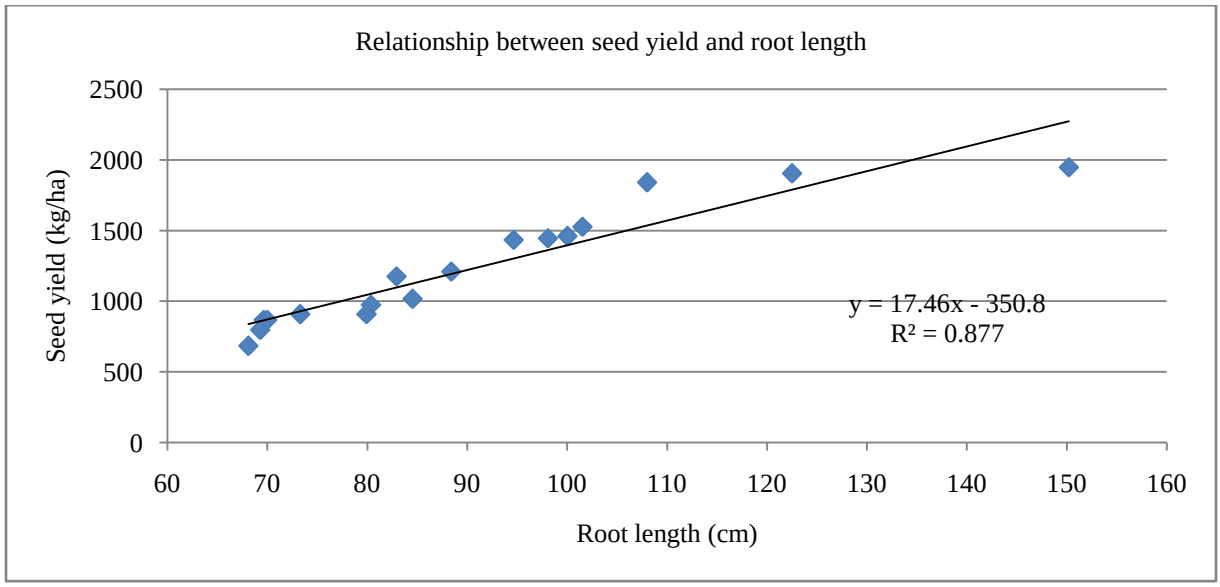


Figure 11 Relationship between seed yield and root length of lentil

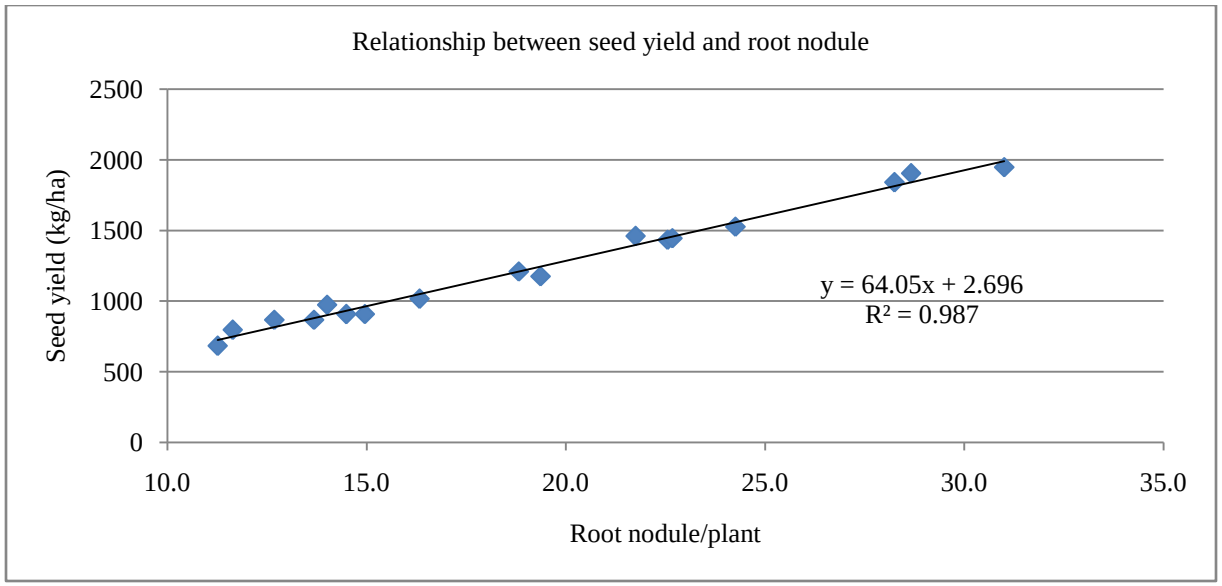


Figure 12 Relationship between seed yield and root nodule of lentil

Table 2 Flowering and maturity time of different lentil varieties

Treatment	Days to 50% at flowering	Days to 50% at pod maturity
BM-7	58	88
BM-5	62	93
ILL-8180	61	90
L-4076	58	89
L-112-7	52	85
ILL-10971	67	99
ILL-237	52	87
ILL-10897	59	89
WBL-81	62	95
RL-12-171	62	96
BM-6	59	93
BM-2	55	88
L-1112-14	62	94
L-1112-6	59	91
ILL-10951	61	94
ILL-10803	60	91
ILL-10805	59	90
SEm±	2.4	1.8
CD	7.1	5.3

Table 3 Performance of different lentil varieties/lines under participatory trial in Tripura

Treatment	Branch/ Plant	Pod/ Plant	Pod weight (g)/ Plant	Seed/pod	1000 Seed weight (g)	Seed yield (kg/ha)
BM-7	7.8	38.8	1.5	1.6	17.0	1209
BM-5	7.3	34.6	1.4	1.8	19.0	1459
ILL-8180	5.8	47.3	2.4	1.4	70.0	1016
L-4076	9.6	118.7	5.0	1.9	19.0	1434
L-112-7	6.7	48.2	3.6	1.4	18.0	1903
ILL-10971	8.0	59.0	3.4	1.4	28.5	867
ILL-237	6.8	48.9	2.1	1.6	38.0	683
ILL-10897	7.5	53.5	3.1	1.2	56.0	796
WBL-81	5.3	40.4	2.0	2.0	22.5	1526
RL-12-171	6.7	71.7	2.4	1.8	17.5	1947
BM-6	7.5	73.5	3.0	1.8	17.0	1444
BM-2	8.7	110.3	4.2	1.4	14.0	1175
L-1112-14	6.5	55.6	2.5	1.9	19.5	868
L-1112-6	9.3	83.4	2.9	1.9	17.0	974
ILL-10951	9.9	63.4	2.1	1.6	18.5	1839
ILL-10803	7.3	46.6	1.7	1.6	24.5	907
ILL-10805	7.7	56.7	2.0	1.7	26.5	908
SEm±	0.41	3.31	0.12	0.09	1.80	76.78
LSD (*p=0.05*)	1.22	9.93	0.36	0.26	5.38	230.19

Conclusion

Tripura has tremendous scope for lentil production as relay crop and as conservation agriculture system in rice fallow. Lentil production and area in Tripura can be increased with timely supply of quality seed and training of farmer's about cultivation and importance of lentil in human nutrition as well in for improving the soil health. Timely sowing of improved lentil varieties with improved production technology like Seed treatment (Rhizobium, fungicides and insecticides), Seed priming with water, conservation tillage, nutrient management, weed management, integrated pest management, foliar spray of urea and post harvest management) can give a good yield to farmer's. Different lentil varieties showed different response in different district of Tripura. Lentil variety WBL-77 produced higher seed yield in Dhalai. However, variety HUL-57 produced the highest seed yield in West Tripura and South Tripura. In general all the varieties shown following pattern of seed yield HUL-57>WBL-58>WBL-77>NDL-1>PL-06. The optimum time for sowing lentil crop from 15th to 20th November was identified which gave highest yield among all date of sowing and the crop sown on 10th December recorded lowest

yield. The Lentil varieties grown under reduced tillage recorded the highest yield however, paira cultivation of lentil produced lowest seed yield. Besides that the line was found much better for cultivation of lentil and produced more seed yield as compared to broadcasting. Seventeen lentil varieties/lines were shown under farmers participatory varietal selection programme. All the lentil varieties had shown different trend in flowering and maturity. The days to 50% flowering and days to 50% pod maturity varies from 52-67 days after sowing (DAS) and 85-99 DAS, respectively. The variety L-112-7 was require minimum days after sowing for 50% flowering and pod maturity. However, variety ILL-10971 need maximum days for 50% flowering and pod maturity. Lentil root length and root nodule were recorded at flowering and pod initiation stage. The lentil variety RL-12-171 was recorded significantly highest root length and root nodule/plant followed by L-112-7 and ILL-10951 as compared to all other lentil varieties. The both root length and root nodule showed a significant linear relationship with seed yield. Yield attributes and yield of lentil was significantly varies among the different lentil varieties. The variety ILL10951 produced maximum number of branches/plant. However, variety L-118.7 was produced maximum number of pods/plant and has highest pod weight. Seed/pod was higher in WBL-81 and ILL-8180 had shown highest test weight. The lentil variety RL-12-171 was recorded significantly highest seed yield/ha followed by L-112-7 and ILL-10951. Realizing very good potential of lentil in rice fallow large scale field demonstrations will be undertaken in farmers' field.

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