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Influence of Irrigation and Mulching on Yield Attributes, Yield and Quality of Lentil (*Lens esculentum* L.) Grown as Intercrop under Limited Water Conditions

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ABSTRACT

A field experiment was carried out at the Instructional farm, Jaguli, Bidhan Chandra Krishi Viswavidyalaya (State Agricultural University), Mohanpur, Nadia (W.B.) to study the effect of irrigation and mulching on growth, productivity and water use efficiency of safflower based intercropping system during two consecutive winter season of 2010-11 and 2011-12. The experiment was laid out in split-split plot design, replicated thrice, having 3 irrigation treatments in the main plots viz. I_1 - rainfed , I_2 - Irrigation at 0.5 IW: CPE ratio, I_3 - irrigation at 0.75 IW : CPE ratio and 2 cropping system in sub-plots viz., C_1 - Sole lentil, C_5 - Safflower-lentil grown as 3:2 ratio, respectively and 2 sub-sub plot treatments viz. M_0 - No mulching, M_1 - Straw mulching. Levels of irrigation, cropping systems and mulching significantly influenced the yield attributing characters and yield of lentil. Among all the levels of irrigation I_3 *i.e.* irrigation at IW: CPE of 0.75 recorded highest values of all yield attributes of lentil. Safflower inter cropped with lentil i.e., C_2 showed better result than sole lentil i.e. C_1 and straw mulching recorded better result over no mulching. Levels of irrigation significantly influenced the seed yield of lentil. The maximum seed yield (756.87 kg ha^{-1}) was recorded under irrigation at IW: CPE of 0.75 followed by irrigation at IW: CPE of 0.50 75 (706.12 kg ha^{-1}) and the lowest seed yield (667.50 kg ha^{-1}) was recorded under rainfed treatment. The seed yield of sole lentil was 855.83 kg ha^{-1} while safflower intercropped with lentil was 564.50 kg ha^{-1}. Different levels of irrigation, cropping systems and mulching did not show any significant influence on the protein content of lentil. The highest protein content (26.79%) was recorded under irrigation at IW: CPE of 0.75.

Keywords: IW: CPE ratio, mulching, water use efficiency, intercropping

Agriculture is the ministry of Indian economy. Agriculture contributes nearly 15% to the Gross Domestic Product (GDP) of India, while about 65 per cent of population is dependent on agriculture for their livelihood. India stands first in the world in area and production of pulses, but still there is a wide gap between demand and supply of pulses. India is the largest producer of pulses in the world, yet it is also the largest importer of pulses. About 90% of the global pigeon pea, 75% of chickpea and 37% of lentil area falls in India (FAO, 2009). Irrigation is one of the most important aspects in modern agriculture to increase crop production. The aim is, limited irrigation water should be applied to get the maximum seed yield per unit of water used by the crop. The relationship between crop growth or crop yield and water use have been a major focus of agricultural research in the arid and semi-arid regions and have been reviewed by many workers (Vaux and Pruit, 1983 and Howell, 1990).

Intercropping is one of the ways to increase crop production instead of sole cropping per unit area. Adoption of suitable intercropping systems might increase the total production through efficient utilization of production factors like space, water, and nutrient and so on. Stability of crop yield

in rainfed situation can be achieved with crop substitution and intercropping (Singh and Rana, 2006). Intercropping of oilseed and pulse crops is one of the ways to increase their production because intercropping is more advantageous than sole cropping of either oilseed or pulse. (Padhi and Panigrahi, 2006). Amongst various approaches adopted for improving the productivity of oilseed crops, intercropping of these crops i.e. pulses + other crops appears to be most viable economically and acceptable socially. It has been observed that intercropping of oilseed with cereals, pulses and fiber crops is one of the best techniques to increase production (Lal, 1997).

MATERIALS AND METHODS

The field experiment was carried out at the Instructional Farm, Jaguli, Bidhan Chandra Krishi Viswavidyalaya (State Agricultural University) Mohanpur, Nadia, West Bengal during two consecutive winter seasons of 2010-11 and 2011-12. The farm is located at the south of tropic of cancer, 22° 56′ N latitude and 88° 32′ E longitudes at an elevation of 9.75 m. above mean sea level (MSL). The soil of the experimental field was fine in texture and clayey in nature having a soil pH-6.85, initial organic carbon (0.58%), total N (0.07%), available P_2O_5 (25.45 kg ha^{-1}) and available K_2O (178.95 kg ha^{-1}), respectively. The experiment was laid out in split-split plot design, replicated thrice, having 3 irrigation treatments in the main plots viz. I_1 - rainfed , I_2 - Irrigation at 0.5 IW : CPE ratio, I_3 - irrigation at 0.75 IW : CPE ratio and 2 cropping system in sub-plots viz. C_1 - Sole lentil and C_2 - Safflower-lentil grown as 3:2 ratio, respectively and 2 sub-sub plot treatments viz. M_0 - No mulching, M_1 - Straw mulching @ 5t rice straw kg ha^{-1}. The crop varieties were *MKH-11*(safflower) and *Asha* (lentil). The respective fertilizer dosages of safflower of N: P_2O_5: K_2O @ 60: 40: 20 kg ha^{-1} and in case of lentil - N: P_2O_5: K_2O @ 20:40:20 kg ha^{-1} was considered as the recommended dose of the crops. It is to be noted that full dose of N, P_2O_5 and K_2O @ 20: 40: 20 kg ha^{-1} in case of pulse crop and 1/3rd of N and full dose of P_2O_5 and K_2O @ 20: 40: 20 kg ha^{-1} in case of safflower will be applied as basal also. Rest amount of N (40 kg ha^{-1}) is to be equally splitted in to two, of which 1st was applied at 30 days after sowing and 2nd was applied at 45 days after sowing, respectively to safflower crop. The crop was sown on the 2nd week of November and harvested on 3rd week of March. The crop was harvested from 3 m × 2m net area of each plot (gross plot size 4 m × 3 m), discarding 1 m around to avoid the border effect and threshed. Total nitrogen content of soil was determined in percentage, according to 7 modified *Kjeldahl* methods as described by Jackson (1973). Available P_2O_5 was determined by Bray and Kurtz (1945) method, as described by Jackson (1973) and available K_2O was determined by using flame photometer (Muhr *et al.* 1965). The data were subjected to statistical analysis using analysis of variance method (Gomez and Gomez, 1984) and the significance of different sources of variations were tested by error mean square using Fisher and Snedecor's 'F" test at probability level of 0.05.

RESULTS AND DISCUSSION

Levels of irrigation significantly influenced the number of pod $plant^{-1}$, number of seed pod^{-1}, number of seeds $plant^{-1}$, seed weight $plant^{-1}$ (g) and 1000 seeds weight (g) of lentil. Among all the levels of irrigation I_3 *i.e.* irrigation at IW: CPE of 0.75 recorded highest values of all yield attributes followed by irrigation at IW: CPE of 0.50 *i.e.*, I_2 and the lowest values were recorded under rainfed *i.e.*, I_1 treatment. Proper moisture in the root zone has helped in translocation of nutrients as well as maintenance of proper hydration for proper functioning of biochemical reaction resulting in maximum values under irrigation at IW: CPE of 0.75 *i.e.* I_3.

Among the cropping systems, safflower inter cropped with lentil i.e., C_2 showed better result than sole lentil i.e. C_1 in case of all yield attributing characters of lentil. This might be due to proper utilization of nutrient, space, moisture and solar radiation in intercropped lentil than sole lentil. Straw mulching recorded better result over no mulching for all yield attributes of lentil. This might be due to minimum evaporation loss under straw mulching.

Levels of irrigation significantly influenced the seed yield of lentil. The maximum seed yield (756.87 kg ha^{-1}) was recorded under irrigation at IW: CPE of 0.75 i.e., I_3 followed by irrigation at IW: CPE of 0.50 i.e., I_2 (706.12 kg ha^{-1}) and the lowest seed yield (667.50 kg ha^{-1}) was recorded under rainfed i.e., I_1

Table 1: Effect of irrigation levels, cropping systems and mulching on number of pod plant^{-1}, seed pod^{-1}, seeds plant^{-1}, seed weight plant^{-1} (g), 1000 seeds weight (g), seed yield (kg ha^{-1}) and protein content (%) of lentil (Pooled data)

Treatments	Pod plant^{-1}	Seeds pod^{-1}	Seeds plant^{-1}	Seed weight plant^{-1} (g)	1000 seed weight (g)	Seed yield (kg ha^{-1})	Protein content (%)
Levels of Irrigation							
I_1	56.32	1.56	89.24	1.69	17.71	667.50	26.40
I_2	66.78	1.62	109.71	1.78	18.43	706.12	26.51
I_3	72.31	1.66	122.27	1.92	19.67	756.87	26.79
S. Em (±)	0.610	0.013	2.526	0.030	0.211	8.58	0.065
C. D. (*p=0.05*)	1.99	0.043	8.23	0.099	0.68	28.00	NS
Cropping Systems							
C_1	61.57	1.57	98.01	1.71	18.33	855.83	26.50
C_2	68.70	1.66	116.14	1.88	18.88	564.50	26.63
S. Em (±)	0.669	0.008	1.255	0.023	0.209	7.04	0.030
C. D. (*p=0.05*)	2.06	0.026	3.86	0.070	NS	21.79	NS
Mulching							
M_0	62.93	1.59	101.84	1.75	18.45	695.66	26.50
M_1	67.35	1.64	112.31	1.84	18.76	724.66	26.63
S. Em (±)	0.774	0.017	0.863	0.018	0.226	5.17	0.033
C. D. (*p=0.05*)	2.26	NS	2.52	0.052	NS	15.10	NS

I_1 - Rain fed; I_2 - Irrigation at IW/CPE ratio of 0.5; I_3 - Irrigation at IW/CPE ratio of 0.75; C_1 - Sole lentil; C_2- Safflower - lentil grown as 3:2 row ratio; M_0 - No mulching; M_1 - Straw mulching @ 5t rice straw per ha.

treatment. The percent increase in seed yield under I_3 over I_2 and I_1 was 7.19% and 13.39%, respectively. Higher seed yield in case of irrigation at IW: CPE of 0.75 i.e., I_3 treatment might be due to the fact that the crop receiving irrigation at early growth stage established its root system deep into the soil for better extraction of moisture from larger volume of soil and also due to favorable moisture condition and better availability of soil moisture at higher frequency of irrigation throughout the growth period which remarkably stimulated the yield attributing characters (Table 1). Increase in lentil seed yield was might be due to increase in irrigation frequency as reported by Sharma and Prasad (1984) and Yusuf *et al*. (1979).

Sole lentil gave higher yield than intercropped one which was mostly resulted from higher number of plant population in the sole stand than intercropping. The seed yield of sole lentil was 855.83 kg ha^{-1} while safflower intercropped with lentil was 564.50 kg ha^{-1} (Table 1).

Straw mulching @ 5 t rice straw ha^{-1} recorded higher seed yield than no mulching. The maximum seed yield of 724.66 kg ha^{-1} was obtained by straw mulching i.e., M_1 while no mulching gave 695.66 kg ha^{-1} seed yield. The percent increase of straw mulching over no mulching was 4.17%.

Different levels of irrigation, cropping systems and mulching did not show any significant influence on the protein content of lentil. The highest protein content (26.79%) was recorded under irrigation at IW: CPE of 0.75 i.e., I_3 followed by irrigation at IW: CPE of 0.50 i.e., I_2 (26.51%) and the lowest protein content (26.40%) was recorded under rainfed i.e., I_1. The protein content (%) of lentil was not affected significantly due to safflower: lentil intercropping system as reported by Kumar *et al.* (2001).

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