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Studies on fertilizer management in linseed (*Linum usitatissimum*) based intercropping systems for sustainable linseed production

D. Badiyala, S. Bhateria and Jatinder Kumar
Department of Agronomy
CSK Himachal Pradesh Krishi Vishvavidyalaya Palampur-176 062, India.

Abstract

A field experiment was conducted for three consecutive years 1999-2000 to 2001-2002 at Palampur with 12 treatments in a randomized block design, consisting of three cropping systems viz., linseed + mustard (5:1), linseed + mustard (4:2) and linseed + wheat (4:2) and four fertility treatments 100% RDF to linseed and no fertilizer to intercrop, 100 % of RDF of linseed crop applied to both the crops, 100 % RDF of linseed and 50 % of RDF of intercrop applied on area basis and application of RDF based on area basis to both the crops. The result revealed that seed yield of linseed was obtained significantly higher in linseed + wheat (4:2) as compared to linseed + mustard intercropping systems. However, the difference in seed yield due to linseed + mustard (5:1) and linseed + mustard (4:2) was found to be non significant during all the years of study. The linseed equivalent yield was also influenced in a similar way due to different intercropping systems. Application of fertilizers *i.e.* 100 % RDF of linseed and 50 % of RDF of intercrop applied on area basis produced significantly higher yield.

Introduction

Recently, intercropping has been recognized as a potential beneficial system of crop production in rain fed areas. Moreover, many researchers working on rain fed farming suggested strongly to substitute sole cropping system following sustainable intercropping in view of efficient resource utilization. Besides many agro economic advantages, intercropping is also considered advantageous in the context of increasing the demand of household and regular employment opportunity to family labour (Billore *et al.*, 1993). Wheat, linseed and mustard are the most dominant *rabi* season crops of Himachal Pradesh. The nutrient requirement of intercropping system is however not known, whereas, small dose in general is applied to linseed+ mustard intercropping. Therefore, the present study was undertaken to find out the optimum and economic nutrient dose for Linseed+wheat.

Not only fertilizer application but also fertilizer application methods play an important role in the supply of nutrients to crop plants. Thus keeping in view the above facts, present study was undertaken.

Material and Methods

A field experiment with twelve treatments was conducted for three consecutive years 1999-2000 to 2001-2002 at the Experimental Farm of CSK, Himachal Pradesh Krishi Vishvavidyalaya, Palampur (H.P.) in randomized block design with three replications. The soil of the experimental site was silty clay loam in texture, having pH 5.6, available nitrogen 326, available phosphorus 12 and available potassium 298 kg/ha.

The treatments comprised of the combinations of three intercropping systems viz., Linseed + mustard (5:1), linseed + mustard (4:2) and linseed + wheat (4:2) and four fertility treatments 100% RDF to linseed (50:40:20 N, P_2O_5, K_2O kg/ha) and no fertilizer to intercrop, 100 % of RDF of linseed crop applied to both the crops, 100 % RDF of linseed and 50 % of RDF of intercrop applied on area basis and application of RDF based on area basis to both the crops. The recommended fertilizer dose of mustard is 60:40:20 N, P_2O_5, K_2O kg/ha and 120:60:40 N, P_2O_5, K_2O kg/ha for wheat. The varieties used were Janaki (linseed), Varuna (mustard) and Surbhi (wheat).

Results and Discussion

Seed yield

Seed yield of linseed was found to be significantly higher with linseed + wheat (4:2), followed by Linseed + mustard (5:1) and linseed + mustard (4:2) during all the years of study (Table 1).

Table1.Effect of fertilizers management in linseed based intercropping systems

Treatments	Seed yield (kg/ha)							Linseed equivalent yield (kg/ha)				Net return (Rs/ha)				Net return per rupee invested (Rs)			
	Linseed				Intercrop														
	99-00	00-01	01-02	Mean	99-00	00-01	01-02	99-00	00-01	01-02	Pooled	99-00	00-01	01-02	Pooled	99-00	00-01	01-02	Mean
Intercropping systems																			
Linseed +mustard (5:1)	877	903	761	847	387	271	346	1184	1031	1028	1093	12346	10186	9846	11009	1.38	1.24	1.12	1.25
Linseed +mustard (4:2)	811	807	694	771	265	275	307	1075	1013	932	1007	10362	8945	8092	9133	1.14	1.00	1.01	1.05
Linseed+ wheat (4:2)	942	986	832	920	761	681	832	1231	1247	1159	1212	13252	13408	12099	12920	1.50	1.47	1.38	1.05
CD (P=0.05)	66	78	62		35	32	68	67	82	62	137	1207	521	1222	2291	0.13	0.13	0.19	0.18
Fertilizer application																			
100% RDF to linseed, no fertilizer to intercrop	946	952	740	879	354	268	310	1169	1100	926	1065	12566	11220	8102	10629	1.48	1.30	0.95	1.24
100 % RDF of linseed applied to both crops	711	653	658	674	435	414	526	997	882	943	929	9472	7295	8506	8424	1.13	0.89	1.08	1.03
100 % RDF of linseed and 50% of RDF of intercrop applied on area basis	968	959	776	901	495	470	583	1285	1252	1079	1206	13643	12943	10559	12382	1.43	1.35	1.20	1.33
Application of RDF based on area to both crops	882	990	875	916	494	484	629	1202	1254	1212	1223	12265	12795	12882	12647	1.31	1.41	1.44	1.39
CD (P=0.05)	76	89	72		40	36	79	77	95	72	159	1393	602	1296	2645	0.16	0.21	0.21	

RDF: recommended dose of fertilizers

Linseed + wheat in the row ratio of 4:2 resulted in 7.93 and 16.2 % higher yields of linseed as compared to linseed + mustard (5:1) and linseed + mustard (4:2), respectively (on pooled mean basis). Lower yields in case of linseed intercropped with mustard could be attributed due to aggressive behavior of crop, which might have caused greater competition for light, water and nutrients, henceforth, resulted in decrease in yield of linseed. Similar results have also been reported by Lal *et al.* (1996) and Pali *et al.* (1997).

In fertilizer application, application of 100 % RDF of linseed and 50 % RDF of intercrop applied on area basis resulted in significantly higher linseed yield in the first year of study and it was found to be at par with application of RDF based on area to both the crops and 100 % RDF to linseed and no fertilizer to intercrop, whereas, in 2001-2002 application of RDF based on area to both the crops resulted in significantly highest linseed yield. Linseed + wheat (4:2) resulted in significantly higher intercrop yield during all the years of experiment, whereas, linseed + mustard (4:2) and linseed + mustard (5:1) were found to be at par with each other during 2000-2001 and 2001-2002 and linseed + mustard (4:2) resulted in significantly lowest intercrop yield during 1999-2000. Application of RDF on the basis of area to both crop resulted in significantly highest yield of intercrop. Higher yields of mustard in mustard+lentil intercropping system (1:1) were obtained when fertilizers were applied in 40:40:40 ratios in combination to both the crops (Kushwaha, 1985).

Linseed equivalent yield

Linseed + wheat intercropping system in 4:2 ratio resulted in significantly highest linseed equivalent yield, whereas, linseed +mustard (5:1) and linseed+ mustard (4:2) cropping systems were found to be at par with each other (pooled basis). Linseed+wheat (4:2) resulted in 16.91 % and 9.82 % higher linseed equivalent yield over linseed+mustard (4:2) and linseed +mustard (5:1), respectively.

Application of recommended dose of fertilizer based on area to both crops resulted in significantly higher linseed equivalent yield and it was found to be at par with 100 % RDF of linseed and 50 % RDF of intercrop applied on area basis. This treatment resulted in 24.04% and 12.92% higher linseed equivalent yield over 100% RDF of linseed applied to both crops and 100 % RDF to linseed and no fertilizer to intercrop, respectively (pooled basis).

Net returns

The linseed +wheat intercropping in 4:2 ratio was found to be more remunerative and gave the highest net return of Rs 12,920/ha, but it was found to be at par with linseed +mustard (5:1) intercropping system, whereas, linseed+mustard (4:2) gave lowest net return of Rs.9,133/ha (pooled basis). Similar trend was recorded for net return per rupee invested.

Application of RDF based on area to both the crops gave the highest net profit of Rs 12,647/ha and it was found to be at par with other treatments except 100 % RDF of linseed applied to both the crops, which gave significantly lowest net return of Rs 8,424 per hectare (pooled basis). Similar trend was also obtained for net return per rupee invested.

It can be concluded from above study that linseed+ wheat (4:2) ratio and application of RDF based on area to both crops is suitable for obtaining higher yield and profits.

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