Int.J.Curr.Microbiol.App.Sci (2018) *7*(6): 2971-2979

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 06 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.706.350

Effect of Leguminous Based Intercropping on Growth, Yield, LER and Monetary Returns Rain Fed Areas

S. S. Kaushik[1*], Pawan Sirothia[2], R. S. Negi[3], Ashok Sharma[3] and Rajesh Garg[3]

[1]Krishi Vigyan Kendra, Dahigaon, Ahmednagar, Maharashtra-414502, India
[2]Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna, M.P., India
[3]Krishi Vigyan Kendra, Majhgawan Satna, M.P.-485331, India

**Corresponding author*

Keywords

Wheat, chickpea, linseed, mustard, wheat equivalent yield, land equivalent ratio, economic viability and intercropping

Article Info

Accepted:
20 May 2018
Available Online:
10 June 2018

A B S T R A C T

A field experiment was conducted during rabi season of 2005-2006 at Krishi Vigyan Kendra, Deendayal Research Institute, Majhagawan, Satna to studies on productivity and economic viability of various wheat based inter cropping systems under rain fed conditions of Kaymore Plateau. The experiment comprised of three intercropping treatments with different row proportions with chickpea, linseed and mustard. The two years study revealed that the leguminous based intercropping i.e. wheat +chickpea in 2:2 row proportions proved better in comparison of other intercropping or sole cropping system in terms of land equivalent ratio (1.36) and total production in terms of actual yield (40.97q/ha), gross return (Rs. 54099), net income (Rs. 42429) and B:C ratio 3.64.

Introduction

Wheat is a major staple food crop of India and is of paramount importance for food security of the country. It has been a staple food with the level of consumption largely unaffected by changes in its prices and the price of substitutes like rice, maize and millets. The current position of production and consumption of both pulses and edible oils in the country clearly shows that there is a big gap between domestic production and consumption which is bridged by imports (Ali and Shiv Kumar, 2007 and Hegde, 2007). To meet the challenges of pulses and oilseed production, there is a need to adopt strategy which involves enhancing production through area expansion and productivity improvement through better adoption of improved technologies.

Intercropping ensures risks against the crop failure due to adverse weather or market fluctuations besides satisfying the dietary requirement of the explosively growing population. The ways of increasing production are either expansion in area or improvement in productivity. In general, there is hardly any scope to bring additional area exclusively under pulses or oilseeds or even wheat as the

demand of land for other crops will continue to rise. Thus there is only way to left is improvement in productivity of crops at the same time minimizing losses by adopting intercropping. Besides, other techniques, intercropping systems of growing two or more crops together on the same piece of land simultaneously may play an important role particularly under rain fed situation, where risk is more in mono cropping system. Hegde (2007) also suggested that there is considerable scope to bring large area under oilseed through intercropping system. Similar case may be with pulses. The success of inter cropping depends mainly on the selection of most compatible crops and their suitable row proportions. Inter crops with main crops are grown in two ways of additive and replacement series.

In additive series, additional population of intercrops is adjusted with full population of main crop per unit area, while in replacement series, population or rows of main crops are replaced by inter crop. In densely sown crop like wheat, particularly under rain fed conditions, inter cropping through replacement series is generally practiced and can be economically viable. In agronomy planting geometry plays an important role in maximizing yield levels in inter cropping systems, which may vary with crop combinations, varieties and locations. Growing of crop without any fixed geometry was always inferior than inter cropping with appropriate geometry of planting.

Materials and Methods

A field experiment was conducted at research farm of Krishi Vigyan Kendra Majhagawan, Satna, Madhya Pradesh during for two consecutive rabi seasons of 2005 and 2006. The experiment was laid out in Randomized Block Design with 3 replications and 13 different treatments combinations with three row proportions (2:2, 4:2, 6:2), three intercropping (wheat + chickpea, wheat + linseed, wheat + mustard) and four sole crop i.e. wheat, chickpea, linseed and mustard. The objective of experiment was to study the effect of various wheat based intercropping system on yield, land equivalent ratio and monetary indices under different row proportions. The soil of experimental area was sandy loam in texture and shallow in depth and soil was very low in available nitrogen, low in available phosphorus and higher in available potassium. Soil class was sandy loam and reaction was almost neutral. The location has subtropical climate characterized by hot dry summer and cool winter. The mean annual rainfall received during the experimental year varies from 600 mm to 850 mm. The varieties selected for wheat (HD-2285), chickpea (Uday), linseed (JLS-9) and for mustard (Rohini) The crop was sown on 19 November 2005 and 14 November 2006. The seed rate of intercrops was decided according to row proportions. Weeding was done to conserve soil moisture through dust mulch created by hand weeding after one month of sowing during both years. Thinning operation was adopted in linseed and mustard crop. The crop was harvested on 22.03.2006 and 20.03.2007.

Results and Discussion

Effect on growth and yield contributing characteristics

It is evident from table 1 that in chickpea intercropping system accumulated significantly more dry matter /plant than in sole crop during both years at maturity stages. It is also clear that different row ratios had no significant effect on dry matter as they remained at par in all observations. On an average, chickpea in intercropping accumulated dry matter 22.5 % higher than sole chickpea at maturity on the basis of pooled results.

Dry matter of linseed could not be influenced significantly by different treatments in any case of observation in the investigation.

The data provided in table 1 indicates that mustard grown in intercropping system accumulated significantly higher dry matter/plant than in sole mustard at maturity stages during both years and also in pooled analysis. However, the row ratio of intercropping system had no significant effect on dry matter accumulation of mustard in any case of investigation.

It is obvious from the table 2 that fruits of all intercrops were produced significantly higher in intercropping than sole stand of respective crops in almost all cases of significance. Between intercropping treatments, different row ratio had no significant effect on fruit formation in any of the intercrops and all row ratios remained at par with each other in respective intercrops. On an average chickpea in intercropping produced 18.0% more pods than in sole chickpea on the basis of pooled results. Similarly, intercropped linseed produced 7.8% more capsules than sole linseed, while mustard in intercropping produced 16.3% more siliquae than in sole mustard in pooled results.

The examination of table 3 that harvest index of intercrops was significantly higher in intercropping than in their sole stand in almost all cases. Difference of intercropping was found significant only in case of mustard, where 6:2 row ratio showed significantly lower harvest index than other ratios in pooled results. It was calculated from pooled data that intercropping system attained higher values of harvest index than sole cropping and margin of increase were found 0.69, 1.2 and 1.11percent unit in case of chickpea, linseed and mustard, respectively. The data furnished in table 4 revealed that seed yield was produced significantly highest in sole crop, which reduced significantly in intercropping with each wider ratio up to 6:2 in all cases except individual years. In year wise analysis, yield reduction beyond 4:2 row ratio was not found to the level of significance. On the basis of pooled data, yield reductions in 2:2, 4:2 and 6:2 row ratios of intercropping as compared to sole stand were found 7.06q/ha or 35.8% 11.21 q/ha or 56.8% and 13.17 q./ha or 66.8%, respectively. Although seed yield in intercropping are lower than in sole stand, but they are higher than expected yields estimated on the basis of actual area sown by chickpea under intercropping treatments. It may be seen from the pooled data given in table 4 that actual seed yields in 2:2, 4:2 and 6:2 row ratios of intercropping are 2.8 q/ha or 28.4%, 1.94q/ha or 29.5% and 1.63q/ha or 33.1% higher than their expected yields, respectively. It indicates about the beneficial effect of intercropping system on seed yield of chickpea, and this effect increased with wider row ratios of intercropping system. The comparison of actual and expected yields.

It is evident from the data given in table 4 revealed that seed yield of linseed was produced significantly highest in sole stand, and reduced in intercropping significantly with each wider row ratio up to widest of 6:2 ratio. On the basis of pooled data as compared to sole stand yield reductions in 2:2, 4:2 and 6:2 row ratios of intercropping were worked out as 5.53 q/ha or 45.4 %, 7.56 q/ha or 62%, and 8.78q/ha or 72%, respectively.

When we compare the actual seed yield of intercropping treatments with respective expected yields (table 4), it is proved that actual yields were higher by 56 kg/ ha or 9.2%, 57 kg/ha or 14.0%, and 36kg/ha or 11.8% under 2:2, 4:2 and 6:2 row ratios than the respective expected yields estimated on the basis of actual area sown under linseed. These calculations were done for pooled results over years.

Table.1 Dry matter /plant (g) of chickpea, linseed and mustard at maturity Stages under different treatments

Year of experiment	Treatments				S.Ed.+-	C.D.(P=0.05)
	Sole crop	2:2	4:2	6:2		
	Chick pea					
2005-06	15.45	19	19.16	19.1	0.69	2.17
2006-07	16.54	20	20.18	20.19	0.7	2.23
Pooled	16	19.5	19.67	19.64	0.49	1.07
	Linseed					
2005-06	3.003	2.961	2.867	2.873	0.114	NS
2006-07	3.102	3.006	2.916	2.909	0.116	NS
Pooled	3.053	2.984	2.892	2.891	0.081	NS
	Mustard					
2005-06	15.37	20.78	20.49	20.46	0.55	1.74
2006-07	16.72	21.7	21.64	21.64	0.63	2
Pooled	16.05	21.24	21.05	21.05	0.42	0.91

Table.2 Number of chickpea pods, linseed capsule and mustard siliquae/plant of intercrops under different treatments

Year of experiment	Treatments				S.Ed.+-	C.D.(P=0.05)
	Sole crop	2:2	4:2	6:2		
	Chick pea Pods					
2005-06	22.15	25.98	27	26.87	1.17	3.73
2006-07	23.2	26.45	27.19	27	1.15	3.66
Pooled	22.67	26.22	27.1	26.94	0.82	1.79
	Linseed Capsule					
2005-06	28.21	31.08	30.34	29.87	1.18	NS
2006-07	28.32	31.17	30.44	30	1.16	NS
Pooled	28.27	31.13	30.39	29.94	0.83	1.8
	Mustard Siliquae					
2005-06	113.22	130.41	134.19	134.96	4.9	15.6
2006-07	118.32	133.14	137.11	138.05	5.61	17.85
Pooled	115.77	131.78	135.65	136.51	3.72	8.11

Table.3 Harvest index (%) of intercrops under different treatments

Year of experiment	Treatments				S.Ed.+-	C.D.(P=0.05)
	Sole crop	2:2	4:2	6:2		
	Chick pea					
2005-06	42.02	43.15	42.21	43.1	0.3	0.95
2006-07	41.97	42.13	42.38	42.14	0.35	NS
Pooled	42	42.64	42.8	42.62	0.23	0.5
	Linseed					
2005-06	38.47	39.98	40.05	40.1	0.34	1.08
2006-07	37.95	38.56	39.18	38.56	0.32	1.01
Pooled	38.21	39.27	39.62	39.33	0.23	0.51
	Mustard					
2005-06	32.72	34.35	34.42	34.3	0.3	0.97
2006-07	32.65	34.2	33.46	32.05	0.31	0.98
Pooled	32.69	34.28	33.94	33.17	0.22	0.47

Table.4 Seed and Stover yield (q/ha) of intercrops under different treatments

Year of experiment	Seed Yield						Stover Yield					
	Treatments				S.Ed.+-	C.D.(P=0.05)	Treatments				S.Ed.+-	C.D.(P=0.05)
	Sole crop	2:2	4:2	6:2			Sole crop	2:2	4:2	6:2		
	Chick pea						Chick pea					
2005-06	19.35	12.51	8.32	6.38	0.83	2.64	26.7	16.57	10.93	8.42	0.83	2.65
2006-07	20.11	12.83	8.71	6.73	0.75	2.39	27.81	17.62	11.84	9.24	0.99	3.15
Pooled	19.73	12.67	8.52	6.56	0.56	1.22	27.26	17.1	11.38	8.83	0.65	1.41
	Linseed						Linseed					
2005-06	11.94	6.57	4.42	3.34	0.41	1.32	19.1	9.86	6.62	4.99	0.61	1.94
2006-07	12.43	6.74	4.85	3.49	0.42	1.34	20.32	10.74	7.53	5.56	0.65	2.06
Pooled	12.19	6.66	4.63	3.41	0.29	0.64	19.71	10.3	7.08	5.28	0.45	0.97
	Mustard						Mustard					
2005-06	13.97	10.41	6.98	5.31	0.38	1.21	28.73	19.9	13.3	10.17	0.86	2.74
2006-07	14.25	10.67	7.23	5.48	0.51	1.62	29.37	20.53	14.38	11.62	0.93	2.95
Pooled	14.11	10.54	7.11	5.39	0.32	0.69	29.06	20.22	13.84	10.9	0.63	1.38

Table.5 Wheat equivalent yield (q/ha) and land equivalent ratio, Gross Income (000 Rs./ha), Net income (000 Rs./ha) and B:C Ratio under different treatments

Treatments	Wheat equivalent yield(q/ha)	Land equivalent ratio	Gross income (000 Rs/ha)	Net income (000 Rs/ha)	B:C ratio
Sole wheat	39.94	1	47.582	36.882	**3.45**
Wheat+chickpea(2:2)	46.04	1.36	54.099	42.429	**3.64**
Wheat+linseed(2:2)	35.86	1.08	41.335	30.52	**2.84**
Wheat+mustard(2:2)	35.14	1.16	41.038	30.203	**2.79**
Wheat+chickpea(4:2)	44.61	1.27	52.72	41.232	**3.59**
Wheat+linseed(4:2)	39.83	1.12	46.486	35.687	**3.31**
Wheat+mustard(4:2)	37.04	1.11	43.957	33.119	**3.06**
Wheat+chickpea(6:2)	44.16	1.23	52.078	40.718	**3.59**
Wheat+linseed(6:2)	41.76	1.14	48.78	37.952	**3.5**
Wheat+mustard(6:2)	38.5	1.1	45.907	25.07	**3.24**
S.Ed.+-	1.92	0.06	2.466	1.914	**0.17**
C.D.(P=0.05)	3.76	0.11	4.834	3.752	**0.33**
Sole intercrop					
Chickpea	27.62	1	30.346	19.146	**1.71**
Linseed	26.82	1	27.795	19.366	**2.09**
Mustard	**25.4**	**1**	**28.306**	**19.589**	**2.15**

Like other interactions, seed yield of mustard also maximized under sole stand and reduced significantly in intercropping (table 4).

In different row ratio of intercropping, seed yield of mustard reduced significantly with each wider row ratio up to widest of 6:2 ratio.

In pooled results the margin of yield reduction in intercropping as compared to sole stand were found 3.57q/ha or 25.3% 7.0 q/ha or 49.6% and 8.72q/ha or 61.8%, respectively in 2:2, 4:2 and 6:2 row ratios treatments.

In comparison of actual yield with expected yields of respective intercropping treatments, actual yield were found always higher than expected yields estimated on the basis of actual area sown under mustard crop in intercropping treatments. The actual yields obtained under 2:2, 4:2 and 6:2 row ratios were computed to be higher than respective expected yields by the margin of 348kg/ha or 49.3%, 241 kg /ha or 51.3% and 186kg/ha or 52.75, respectively on the basis of pooled data.

It is clear from the table 4 that stover yield was produced significantly highest in sole stand of all intercrops during both years. Stover yield reduced in intercropping with each wider row ratio up to widest of 6:2 ratio in all cases but reduction beyond 4:2 row ratio was significant only in pooled results. On the basis of pooled data yield reduction in intercropping as compared to sole stand were found to be 10.16 q/ha or 37.3%, 15.88 q/ha or 48.3%, and 18.43 q/ha or 67.6% under 2:2, 4:2 and 6:2 row ratios, respectively in case of chickpea. Such reduction in linseed were found as 9.41 q/ha or 47.77%, 12.63 q/ha or 64.1%, and 14.43 q/ha or 73.2% and in mustard as 8.84q/ha or 30.4%, 15.22q/ha or 52.4%, and 18.16 q/ha or 62.5%, respectively.

Wheat Equivalent Yield, Land Equivalent Ratio and Monetary Returns

Wheat equivalent yield was significantly influenced by treatments during both years and also in pooling. The pooled data show that wheat +chickpea in 2:2 and 6:2 row ratios produced significantly higher wheat equivalent yield than all the other treatment combinations. Among remaining treatments wheat + linseed in 6:2 row ratio being at par with sole wheat, wheat +linseed in 4:2 row ratio and wheat +mustard in 6:2 row ratio gave significantly higher equivalent yield than rest of the treatments. It may also be seen from the table 4.40 that wheat equivalent yield increased with each wider row ratio in wheat, linseed or mustard intercropping but reduced in wheat +chickpea intercropping numerically.

The treatment of wheat +chickpea in 2:2 row ratio produced highest of 46.04q/ha wheat equivalent yield, which was 1.43 q/ha or 3.21%, 1.88q/ha or 4.26%, 4.28q/ha or 10.25% and 6.10 q/ha or 15.27% higher than equivalent yield under wheat +chickpea in 4:2 row ratio and 6:2 row ratio, wheat +linseed in 6:2 row ratio and sole wheat, respectively. Wheat equivalent yield of pure intercrops was recorded much lesser than sole wheat or all the intercropping treatments.

It is visible from Table 5 that the treatment wheat +chickpea in 2:2 row ratio being at par with 4:2 ratio attained significantly higher values of LER than remaining all treatments. All treatment of intercropping showed higher LER values than sole wheat crop, but difference was not found significant under wheat +linseed in 2:2 row ratio, wheat +mustard in 4:2 and 6:2 row ratio of intercropping.

The data furnished in table 5 clearly indicate that effect of treatments was significant on gross income during both years. Pooled data show that the treatment wheat +chickpea in 2:2 row ratio earned maximum gross income from same intercropping in 4:2 (Rs 52720/ha) and 6:2 (Rs 52078/ha) row ratio. But significantly higher than all other treatments. It may be seen that wheat +linseed intercropping earned higher income than wheat + mustard intercroppings in all row ratios, but difference was not significant. The intercropping of wheat + linseed earned significantly lesser income in 2:2 row ratio than both other ratios, while income from wheat +mustard system did not vary significantly under different row ratios. The best treatment of wheat +chickpea in 2:2 row ratio recorded Rs. 1379/ha or 2.6%, Rs.2021/ha or 3.9%, Rs. 5319/ha or 10.9%, Rs. 6517/ha or 13.7% higher income compared with the income from following treatments, wheat +chickpea in 4:2 row ratio, in 6:2 row ratio and sole wheat, respectively. However all intercropping treatments gave higher income than sole cropping of any intercrop except wheat +chickpea, none of intercropping earn significantly higher gross income than sole wheat.

The data given in table 5 clearly indicate that wheat +chickpea in all row ratios being at par gained significantly higher net income than all other treatments on pooled basis over years. The highest net income of (Rs 42429/ha) was obtained with wheat +chickpea in 2:2 row ratio, which was found higher by Rs. 1197/ha or 2.9%, Rs.1711/ha or 4.2%, Rs. 4477/ha or 11.8%, Rs. 5547/ha or 15.0% than the net income with wheat +chickpea in 4:2, in 6:2 row ratios, wheat +linseed in 6:2 row ratio and sole wheat, respectively. The intercroppings of wheat +linseed or wheat +mustard in any ratio could not give significantly higher net income than sole wheat. Not only had this, but wheat + linseed or mustard in 2:2 row ratio given significantly lesser net income than sole wheat. Sole

cropping of intercrops gave much lesser net income than sole wheat or different intercropping systems.

It is apparent from table 5 that B: C ratio behaved in almost similar manner to net income. The treatment of wheat +chickpea in 2:2 row ratio gave highest B:C ratio of 3.64, which was found at par with B:C ratio of same intercropping in 4:2 and 6:2 row ratios, wheat +linseed in 6:2 row ratio and sole wheat, but significantly higher than ratio of all other treatments. The treatments of wheat +linseed or mustard in 2:2 row ratio gave minimum value of B: C ratio. Sole crops of all intercrops have given much lesser B: C ratio than sole wheat or all intercropping treatments.

References

Balyan, J.S.1997. Performance of maize (Zea mays) based intercropping systems and their after effect on wheat (*Triticum aestivum*). In *Proceedings of National Symposium on Cropping Systems* (M. Pal, Ed.) held at CSSRI, Karnal, 3-5 April, 1995.

Barik, P., Midya, A., Sarkar, B.K. and Ghasa, S.S. 2006. Wheat and chickpea intercropping systems in an additive series experiment: advantages and weed smothering. *European Journal of Agronomy* 24(4): 325-332.

Hegde, D.M.2007. Oilseeds: Increasing production area. *The Hindu Survey of Indian Agriculture*. pp. 42-45.

Hosmani, M.M., Chittapur, B.M.and Hiremath, S.M. (Eds) 1990 *Intercropping Principles and Practices*, University of Agricultural Sciences, Dharwad.

Mallik, A., Verma, U.N., Thakur, R. and Srivastav, V.C.1993.Productivity of wheat (*Triticum aestivum*) based intercropping system under limited irrigation. *Indian Journal of Agronomy 38 (2)*: 178-181.

Mandal, B.K., Das, D., Saha, A. And Mohasin, M.D. 1996. Yield advantages of wheat (*Triticum aestivum*) and chickpea (*Cicer arietinum*) under different spatial arrangements in intercropping. *Indian Journal of Agronomy 41 (1)*: 17-21.

Mishra, B.2007. Wheat: quality based procurement. *The Hindu Survey of Indian Agriculture*. pp. 32-35.

Reddy, S.R. 2004. Cropping systems, resource use and plant interaction: competitive relationships. *Principles of Crop Production*. Kalyani Publishers, New Delhi. pp. 531-532.

Sharma, R.P., Roy, R.K., Singh, A.K., and Jha, R.N. 1987. Production potential of wheat and gram in sole and mixed /intercropping systems. *Indian Journal of Agronomy* 32(3): 235-237.

Singh, A and Turkhade, B.B., Prasad, R., Singh, R.K., Singh, K.D. and Bhargava, S.C. 1992. Effect of wheat (*Triticum aestivum*) + linseed *(Linum usitatissimum*) intercropping on moisture use. *Indian Journal of Agronomy 37 (1)*: 142-143.

Singh, A., and Turkhade, B.B. 1989. Fertilizer management in wheat + linseed intercropping system under rain fed conditions. *Indian Journal of Agronomy* 34(3): 297-301.

Srivastav, R.K. and Bohra, J.S. 2006. Performance of wheat (*Triticum aestivum*), and Indian mustard (*Brassica juncea*) intercropping in relation to row ratio, Indian mustard variety and fertility levels. *Indian Journal of Agronomy 51(2)*: 107-111.

Tomar, S.K., Singh, H.P. and Ahlawat, I.P.S. 1997. Dry matter accumulation and N uptake in wheat (*Triticum aestivum*) based intercropping systems as affected

by N fertilizer. *Indian Journal of Agronomy 42 (1)*: 33-37.

Willey, R.W. 1979. Intercropping: Its importance research needs Part-I: Competition and yield advantages. *Field Crop Abstract* 32:1-10.

Yadav, R.L., Prasad, K. and Dwivedi, B.S. 1998. Cropping System Research. *Fifty years of Agronomic Research in India*. Edited *Yadav, R.L., Singh, Punjab, Prasad, R.* and *Ahalawat, I.P.S.* A publication of Indian Society of Agronomy, New Delhi pp. 193-220.

How to cite this article:

Kaushik S. S., Pawan Sirothia, R. S. Negi, Ashok Sharma and Rajesh Garg. 2018. Effect of Leguminous Based Intercropping on Growth, Yield, LER and Monetary Returns Rain Fed Areas. *Int.J.Curr.Microbiol.App.Sci.* 7(06): 2971-2979.
doi: https://doi.org/10.20546/ijcmas.2018.706.350