

Efficient use of resources by wheat-lucerne mixed cropping

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ABSTRACT

Field experiment on agro-economic relationship of component crops in a wheat-lucerne mixed cropping system was conducted during the *rabi* and summer seasons of 2014-15 to 2016-17. The objectives of the study were to study the effects of mixed cropping system on the yield, yield components of wheat and lucerne, sowing method, seed rate of the crops and efficiency of resource utilization by determining land equivalent ratio (LER). Mixed cropping treatment resulted higher average wheat & lucerne grain yield and wheat equivalent yield as compared to sole cropping. Further results showed that the highest (1.83) land equivalent ratio (LER) and B:C ratio (1:2.13) for total grain and straw yields were observed in the mixed cropping treatment of wheat @ 120 kg/ha (Broadcasting) + lucerne @ 12 kg/ha (Broadcasting), however all growth and yield attributing characters found non-significant except test weight.

Key words: wheat, lucerne, mixed cropping, LER, monetary advantage

Wheat is the second most important staple food crop. Intensive cropping system depletes nutrients from the soil. Therefore, it is necessary to provide sufficient amount of nutrients from outside in the form of organic or inorganic way. Besides, this suitable cropping system e.g. mix cropping is an alternative which add plant nutrients in the soil for realizing maximum yield and sustain soil health. Mix cropping of wheat-lucerne has immense importance in North Gujarat, where the per capita land holding is very low. N-fixation by lucerne in soil will help in increasing yield of wheat and succeeding crop. Lucerne not increases the nutritive value of wheat fodder but also helps in sustaining soil productivity. Intercropping of cereal with legume has been popular in rainfed areas due to its low cost of production and high monetary returns to the farmers (Ofori and Stern, 1987), improving

yield stability, socio-economic status and some other advantages (Willey, 1979). Feasibility of wheat and lucerne as mixed cropping during winter season in north Gujarat is required to be tested as most of the farmers grown wheat crop and hiring the live stock as mix farming within small land holding. Thus, the aim of the study is to determine the best treatment combination, its economic and efficiency of resource utilization by determining land equivalent ratio (LER). Considering the above facts, this experiment was conducted to know the efficient use of resources by wheat-lucerne mixed cropping by interacting the sowing methods and varying levels of lucerne seed rate.

MATERIALS AND METHODS

A field experiment was conducted during the *rabi* and summer seasons of 2014-15 to 2016-17. The experimental soil was sandy loam with pH 7.7, electrical conductivity (EC) 0.32 dS/m.

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organic carbon 0.32 % with available 159 kg ha⁻¹ N and 38.2 kg ha⁻¹ P₂O₅. The experiment was laid out in Randomized Block design with four replications. The treatments composting: T₁: Wheat @ 120 kg ha⁻¹ (Broadcasting) + Lucerne @ 8 kg ha⁻¹ (Broadcasting), T₂: Wheat @ 120 kg ha⁻¹ (Broadcasting) + Lucerne @ 12 kg ha⁻¹ (Broadcasting), T₃: Wheat @ 120 kg ha⁻¹ (Line sowing) + Lucerne @ 8 kg ha⁻¹ (Broadcasting), T₄: Wheat @ 120 kg ha⁻¹ (Line sowing) + Lucerne @ 12 kg ha⁻¹ (Broadcasting), T₅: Wheat sole @ 120 kg ha⁻¹ (Line sowing), T₆: Lucerne sole @ 15 kg ha⁻¹ (Broadcasting). Line sowing of wheat under treatments T₃, T₄ & T₅ was carried out at 22.5 cm spacing between two rows, while, wheat broadcast under treatments T₁ & T₂. Lucerne was broadcast under all the treatments at the time of wheat sowing. FYM @ 10 tone ha⁻¹ was applied in *kharif* 2014 as a common dose. Recommended fertilizer dose i.e. 120:60:0 kg NPK ha⁻¹ was applied to wheat sole and wheat + lucerne mix cropping treatments during all the experimental years, while, 20:80:0 kg NPK ha⁻¹ was applied to lucerne sole treatment. Lucerne crop was supplemented with 40 kg N ha⁻¹ for seed production after wheat harvest. Seven Irrigations (including sowing irrigation) were applied to during wheat crop period and four irrigations applied to lucerne crop at 7, 22, 42 and 60 days after harvest of wheat for lucerne seed production. The experiment was sown on 15th, 24th and 16th November, 2014, 2015 and 2016, respectively. In order to evaluate the competitive effects between wheat and lucerne crops and to determine its performance as mix and sole crop, yield and yield attributing characters along with economics for each treatment were recorded. LER values were calculated according to Willey (1979) using the following formula:

$$LER = LER(\text{wheat}) + LER(\text{lucerne})$$

$$= (Y_{wm} / Y_{ws}) + (Y_{lm} / Y_{ls})$$

Where, Y_{ws} and Y_{ls} are the yields of wheat and lucerne as sole crop, and Y_{wm} and Y_{lm} are the

yields of wheat and lucerne as mixed crop, respectively.

RESULTS AND DISCUSSION

Growth and yield attributes of wheat

Growth and yield attributes of wheat were not significantly influenced by different treatments except test weight (g) on the basis of pooled data (Table 1).

Grains/ear head:

The effect of different treatments was found non-significant on number of grains/ear head. However, numerically higher (39) grains were recorded under treatment T₄ (Wheat @ 120 Kg/ha (Line sowing) + Lucerne @ 12 Kg/ha (Broadcasting)).

Tillers/m²

Effect of different treatments was found non-significant on tillers/m² of wheat. However, T₁ (Wheat @ 120 Kg/ha (Broadcasting) + Lucerne @ 8 Kg/ha (Broadcasting)) recorded numerically higher tillers/m² (414).

Earhead length (cm)

Earhead length (cm) of wheat was found non-significant among different treatments. However, numerically higher earhead length recorded in T₁, T₂ & T₄ (8.2 cm).

Test weight (g)

Test weight was significantly affected by different treatments. Result revealed that significantly the highest test weight (48.1 g) was recorded under T₂ (Wheat @ 120 Kg/ha (Broadcasting) + Lucerne @ 12 Kg/ha (Broadcasting)). It might be due to efficiently utilization of nitrogen which was additionally fixed by lucerne and other nutrients which positively affect on grain filling and ultimately resulted into higher test weight. This finding is in accordance with the findings of Ahmad, (1989), Singh, (1994), Akter, *et al.*, (2004) and Çiftçi and Ülker (2005).

Wheat grain & straw yield

Sowing of wheat @ 120 kg/ha along with lucerne @ 12 kg/ha through broadcasting method as mix crop recorded significantly the highest wheat grain yield (46.82 q/ha) and straw (wheat + lucerne mix) yield (67.62 q/ha) on pooled basis (Table 2). Due to broadcasting of wheat and lucerne, land and other resources were efficiently used by plant roots which reflect on higher test wt. (48.1 g) of wheat and ultimately the highest wheat grain yield as compare to rest of the treatments. Seed rate of wheat was equal for all the treatments, but it was variance for lucerne. So, when lucerne seed rate was increase, the number of lucerne plants also increase as compare to lower seed rate which reflects on the highest straw (wheat + lucerne mix) yield. These findings are in accordance with Ahmad, (1989), Singh, (1994), Akter, *et al.*, (2004), Çiftçi and Ülker, (2005) and Yagmur and Kaydan, (2006).

Lucerne seed & straw yield

Lucerne seed yield was found significant on pooled basis (Table 2). Treatment T₂ (Wheat @ 120 Kg/ha (Broadcasting) + Lucerne @ 12 Kg/ha (Broadcasting)) recorded significantly higher lucerne grain yield (1.83 q/ha). Though remaining all the treatment were at par with treatment T₂ except T₃ with respect to the lucerne seed yield. There was no significant difference found among the treatments for lucerne straw yield. However, the treatment T₆ (Sole lucerne @ 15 kg/ha broadcasting) produced higher lucerne straw yield (46.26 q/ha) followed by treatments T₂ (44.47 q/ha) and T₄ (43.04 q/ha), respectively.

It might be due to higher lucerne seed rate and increase number of tillers per plant after every cut of lucerne for green fodder purpose. This finding was in accordance with Ahmad, (1989), Singh, (1994), Akter, *et al.*, (2004), Çiftçi and Ülker, (2005) and Yagmur and Kaydan, (2006).

Wheat equivalent yield

Wheat equivalent yield was significantly

influenced due to mix cropping treatments. Significantly the highest wheat equivalent yield (79.22 q/ha) was recorded with T₂ i.e. the sowing of wheat @ 120 kg/ha and lucerne @ 12 kg/ha by adopting broadcasting method. Among the mix cropping treatments, treatment T₃ i.e. sowing of wheat @ 120 kg/ha in the line keeping 22.5 cm distance between two rows and broadcasting of lucerne @ 8 kg/ha produced the lowest wheat equivalent yield (68.02) but it was at par with lucerne broadcasted @ 12 kg/ha.

This result was observed due to efficient utilization of resources i.e. land, water and nutrients by increasing wheat yield as well as lucerne seed yield. The difference amongs the treatment for wheat + lucerne straw yield was due to the difference of seed rate of lucerne as per the treatments. These results agree with the finding of Willey (1979), Ofori *et al.* (1987) & Chen *et al.* (2004).

Land Equivalent Ratio

Significantly the highest LER (1.83) value was obtained when wheat and lucerne crop broadcasted @ 120 & 12 kg/ha, respectively. This result was obtained due to higher wheat grain and straw (wheat + lucerne) yield as well as lucerne seed production by efficient utilization of resources as compare to sole (wheat & lucerne) crop. These results collaborative with the findings of Ofori & Stern, (1987), Willey (1979), Caballero *et al.*, (1995) and Dhima *et al.* (2007). Economics

Economics was calculated on the basis of wheat equivalent yield. Wheat and lucerne mix cropping treatments rewarded higher net return and benefit: cost ratio as compared to its sole sowing. Among all the treatments, sowing of wheat @ 120 kg/ha along with lucerne @ 12 kg/ha through broadcasting method recorded the highest net return (Rs. 73571/-) and benefit: cost ratio (1:2.13) followed by treatment T₁ (net return Rs. 63800/- & 1:2.01 BCR). It might be due to increase in wheat equivalent yield without increasing cultivation cost except lucerne seed

Table 1 Effect of mixed cropping treatments on growth and yield attributes of wheat

Treatment	Plant stand /meter ²	Plant height (cm)	Earhead length (cm)	No. grains/ Earhead	of	Heading days	Maturity days	Tillers /meter ² (No.)	1000 grain (g)	wt.
T ₁ : Wheat @ 120 Kg/ha (Broadcasting)										
+ Lucerne @ 8 Kg/ha (Broadcasting)	365	84.0	8.2	38		61	103	414	46.0	
T ₂ : Wheat @ 120 Kg/ha (Broadcasting)										
+ Lucerne @ 12 Kg/ha (Broadcasting)	354	84.4	8.2	38		60	103	409	48.1	
T ₃ : Wheat @ 120 Kg/ha Line sowing) + Lucerne @ 8 Kg/ha Broadcasting)	345	85.0	8.0	38		60	102	409	44.9	
T ₄ : Wheat @ 120 Kg/ha (Line sowing) + Lucerne @ 12 Kg/ha (Broadcasting)	361	85.9	8.2	39		60	103	398	46.0	
T ₅ : Wheat @ sole 120 Kg/ha (Line sowing)	362	85.1	8.1	38		60	103	406	45.1	
T ₆ : Lucerne @ sole 15 Kg/ha (Broadcasting)*	-	-	-	-		-	-	-	-	
S.Em.±	9.62	0.91	0.08	1.01		0.27	0.37	9.83	0.43	
CD at 5%	NS	NS	NS	NS		NS	NS	NS	1.2	
CV%	9.33	3.74	3.64	9.19		1.56	1.24	8.37	3.25	

*Treatment T₆ i.e. sole lucerne @ 15 kg/ha (Broadcasting): There is no need of comparison of lucerne parameters with wheat parameters

Table 2 Effect of mixed cropping on yield of wheat, lucerne, wheat equivalent yield, LER and economics on pooled basis

Treatment	Wheat yield (q/ha)		Lucerne yield (q/ha)		Wheat equivalent yield (q/ha)	LER	Cost of cultivation Rs.	Net return Rs.	BCR
	Grain	Straw (wheat + lucerne)	Grain	Straw					
T ₁ : Wheat @ 120 Kg/ha (Broadcasting) + Lucerne @ 8 Kg/ha (Broadcasting)	41.77	58.88	1.73	44.15	72.53	1.67	63128	63800	1:2.01
T ₂ : Wheat @ 120 Kg/ha (Broadcasting) + Lucerne @ 12 Kg/ha (Broadcasting)	46.82	67.62	1.83	44.47	79.22	1.83	65064	73571	1:2.13
T ₃ : Wheat @ 120 Kg/ha (Line sowing) + Lucerne @ 8 Kg/ha (Broadcasting)	40.96	59.69	1.47	39.68	68.02	1.56	63793	55242	1:1.87
T ₄ : Wheat @ 120 Kg/ha (Line sowing) + Lucerne @ 12 Kg/ha (Broadcasting)	39.42	58.73	1.66	43.04	69.14	1.59	65729	55266	1:1.84
Wheat @ sole 120 Kg/ha (Line sowing)	41.39	53.15	-	-	44.42	-	43145	34590	1:1.80
T ₆ : Lucerne sole @ 15 Kg/ha (Broadcasting)	-	-	1.63	46.26	45.34	-	55741	23604	1:1.42
S.E.m.±	1.00	1.55	0.08	1.64	1.38	0.03	-	-	-
CD at 5%	2.83	4.42	0.22	NS	3.91	0.09	-	-	-
CV%	8.20	9.03	15.85	13.04	7.56	6.76	-	-	-

cost. These results were closely related with the findings of Willey (1979) and Ofori & Stern, (1987).

CONCLUSION

It is concluded that growing of wheat and lucerne as mixed crops by broadcasting @120 and 12 kg/ha, respectively produced maximum wheat grain and lucerne seed yield as well as straw yield of both the crops. Maximum net returns and BC ratio also obtained with same cropping system.

REFERENCES

- Ahmad, N. 1989. Studies on agro-economic relationship of component crops in a lentils-wheat intercropping system, M.Sc. (Hons) Thesis, University of Agriculture, Faisalabad.
- Akter, N., Alim, M.A., Islam, M.M., Naher, Z., Rahman, M. and Hossain, A.S.M. I. 2004. Evaluation of mixed and intercropping of lentils and wheat, *Journal of Agronomy*. **3** (1): 48-51.
- Caballero, R., Goicoechea, E. L. and Hernaiz, P.J. 1995. Forage yields and quality of common vetch and oat sown at varying seeding ratios and seeding rates of common vetch. *Field Crop Res.* **41**: 135-140.
- Ciftci, V. and Ulker, M. 2005. Effect of mixed cropping lentils with wheat and barley at different seeding ratios. *J. of Agronomy*. **4** (1): 1-4.
- Chen, C., Westcott, M., Neill, K., Wichman, D. and Knox, M. 2004. Row configuration and and nitrogen application for barley-pea intercropping in Montana. *Journal of Agronomy*, 96 (2004), pp. 1730-1738.
- Dhima, K. V., Lithourgidis, A. A., Vasilakoglou, I. B. and Dordas, C. A. 2007. Competition indices of common vetch and cereal intercrops in two seeding ratio, *Field Crop Res.* **100**: 249-256.
- Mead, R. and Willey, R.W. 1980. The concept of a land equivalent ratio and advantages in yields for intercropping. *Exp. Agric.* **16**: 217-228.
- Ofori, F. and Stern, W.R. 1987. Cereal-legume intercropping systems, *Adv. Agron.* **41**: 41-90.
- Singh, R.K. 1996. Nutrient management in wheat-lentils intercropping system under dry-land conditions, *Lens News let.* **23** (1/2): 38-44.
- Willey, R.W. 1979. Intercropping: Its importance and research needs, Part 1. Competition and yield advantages, *Field Crops Abst.* **32**: 1-10.
- Yagmur, M. and Kaydan, D. 2006. Different intercrop arrangement with lentils and barley under dry land condition. *Pakistan J. of Biological Sciences.* **9** (10): 1917-1922.