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BIOLOGICAL AND LAND-USE EFFICIENCY OF DIFFERENT BARLEY-BASED INTERCROPPING SYSTEMS

Muhammad Shafi Nazir, M. Saeed, Shahzad Ahmad & A. Ghaffar
University of Agriculture, Faisalabad

Biological efficiency and economics of different barley-based intercropping systems were studied on a sandy clay loam soil at the University of Agriculture. Faisalabad during the year 1991-92. The intercropping systems comprised barley alone. barley + lentil, barley + gram, barley + Fenugreek (methra), barley + linseed and barley + wheat. Barley was sown in lOO cm spaced 4-row strips with 20 cm space between the rows of each strip. Three rows of each intercrop were sown between the barley strips. Although all the intercrops reduced grain yield of barley significantly compared to its monocropping, yet the additional yield obtained from each intercrop compensated more than the losses in barley production. The land equivalent ratio showed 28 to 45 % yield advantage of different intercropping systems over sole cropping. The highest yield advantage (45 %) was recorded in barley + lentil followed by barley + gram (38 %) against the minimum of 28 % in barley + methra and barley + wheat. Similarly, all the intercropping systems gave substantially higher net income ha ' over pure stand of barley. The maximum net income of Rs. 10367 ha' was obtained from barley + lentil intercropping system against the minimum of Rs. 6641 ha' from sole cropping. The results suggest that barley + lentil is the best intercro PPing system in all res Pects.

Key words: barley, biological efficiency, intercropping systems

INTRODUCTION

The population of Pakistan is increasing at an alarming rate but the rate of increase in food production is too slow to meet the rapidly increasing demand for food. Thus the farmers and agronomists are faced with the task of increasing food production. This necessitates to develop new crop management practices to enhance crop productivity per unit area and time. Raising productivity through a more effective use of natural (e.g. light) and added (e.g. water. fertilizer, etc.) resources, is possible through intercropping, provided component crops' demands for resources arc well understood (Kalrab and Gangwar. 1980: Riaz *et al.,* 1993). Recent research has shown substantial yield advantage of intercropping over monocropping or different crops (Manda] and Mahapatra, 1990 and Patrick *et al., 1995).*

Barley *(Hordeum vulgare* L,) has a distinction of being the first grain crop to he cultivated and used as food by mankind. It is very rich in protein (7.5 to 15%) and starch (50-60%). Thus barley is considered to he as valuable as the same weight of maize grain for livestock feeding. It has a wide range of adaptation to soil and climatic conditions. Even it can withstand adverse agro-environment.

At present there is a great need for increased production of rood grains. pulses and oilsccds because of their ever increasing use in the daily human diet. Area under these crops, however. cannot be increased due to their competition with wheat in rahi season. So, the hest way to increase the production or barley, lentil *(Lens culinaris* Medic), gram *(Cicer arietinum* L.), mcthra *(Trigollel/a j(ienugraecum),* linseed *il inutn usuaussimum* L,) and wheat *(Triticum aestivum* L:) may be through intercropping. The present study was, therefore, designed to determine the bio-economic efficiency of different harley-based mrercroppins systems under the irrigated conditions at Faisalabad.

MATERIALS AND METHODS

The investigations were carried out on a sandy clay loam soil at the University of Agriculture, Faisalabad during the year 1991-92. The intercropping systems comprised barley alone, barley + lentil, barley + gram, barley + Fenugreek (methra), barley + linseed and barley + wheat. All the intercrops were also grown alone in the same experimental area to compute the land equivalent ratio (LER). The experiment was laid out in a randomized complete block design with three replications. The net plot size measured 4.80 x 5.30 m.

Barley variety Jau-83 was planted on November 25,1991. The crop was sown with single-row hand drill, in 100 cm spaced 4-row strips on a well prepared seedbed. The distance between the rows of each strip was 20 cm. The seed rate used was 60 kg ha'. Three rows of each intercrop were sown between the barley strips on the same day. A basal dose of 50 kg Nand 100 kg Pps ha' in the form of urea and single super phosphate. respectively was applied. The whole of Pps and half of nitrogen were added at sowing, while the remaining half of nitrogen was top-dressed with first irrigation. In all two irrigations, each of 7.5 cm, were given to mature the crops. All other agronomic practices were kept normal and uniform for all the treatments.

The component crops were harvested at the end of April, 1992. Ohservations on yield and yield components of the component crops were recorded by using the standard procedures. Land equivalent ratio (LER) for each crop was computed by using

the following formula of Willey (1979):

$$\text{LER} = \frac{\text{Intercrop yield}}{\text{Sole crop yield}}$$

The data obtained were analysed by using the Fisher's analysis or variance and DMR test was applied at P =' 0.5 to compare differences among the treatment means (Steel and Torrie , 19X4).

RESULTS AND DISCUSSION

Biological Yield: All the iniercrops reduced biomass yield ha ı of barley compared to that of the sole barley crop (Table 1) because of simultaneous competition among the component crops. Among the intercrops. lentil, gram and methra had signilicantly less effect on biomass yield of barley than linseed and wheat which were at par with each other. This was attributed to the continuous exhaustive competition of linseed and wheat with barley. The biomass yield of intercrops also varied signifICantly. Wheat produced significanrly higher hiornass yield ha ı than all other intercrops, followed by lentil and linseed, which gave equal biomass. The minimum biomass was produced by gram. Reduction in biomass yield of base crop due to competitive effect of different intercrops was also reported by Rehman (1984) and Mandal and Mahapatra (1990).

Grain Yield: Different irucrcrops decreased the grain yield ha ı of barley SIgnificantly compared to its pure stand (Table 1). "111 reduction was signi ficantly higher in linseed and wheat mtercropping than that of lentil. gram and methra. However. lentil and gram had a similar suppressive effect on grain yield or barley. These results are supported by those of Prasact *et al.* (198X). Tarecn *et at.* (1988), Abo-Shelaia (1990). Bajwa *et al.* (1992) and Riaz *et al.* (1993) who reported differential suppressive ellecl of intcrcrops on the yield of the base crop. There were significant differences 111 grain yield ha ı of the intercrops. Wheat produced the maximum grain yield of 1051 kg ha ı against the lowest of 262 kg ha ı for gram. However. lentil and linseed did not signiticantly differ from each other.

Spikes m'l of Barley: Significant differences 1-1-1 number of spikes m'' of barley were recorded among different intercropping systems (Table I). Barley alone produced signiricantly greater number or spikes m - than that grown in association with different crops. Among the inrercrops, linseed and wheat significantly decreased the spikes m' of barley than other imcrcrops but were at par with each other. However. gram had the least effect on spikes m' of barley, These differcnccx were attributed to the variable inicrcrop competition among the component crops of different intercropping systems. Similar suppressive effect of inicrcrops on number of spikes

Table 1. Plant biomass, [illegible] yield and yield components of barley. land equivalent [illegible] and net income as influenced by different barley-based intercropping system

Intercropping system	Biomass yield		Grain yield		Spikes of barley (m^{-2})	No. of grains spikes	1000 grain weight of barley (g)	Land equivalent ratio (LER)	Net income (Rs Ha^{-1})
	Barley (kg ha^{-1})	Intercrop (kg ha^{-1})	Barley (kg ha^{-1})	Intercrop (kg ha^{-1})					
Barley alone	[illegible]	-	2575a	-	271a	44a	41.6a	1.00	6641
Barley + lentil	[illegible]	[illegible]	1839b	629b	248c	40b	39.3b	1.45	10367
Barley + gram	[illegible]	[illegible]	2023b	262d	263b	42b	40.3b	1.38	7012
Barley + methra	[illegible]	[illegible]	1711c	530c	247c	39c	39.6b	1.28	8082
Barley + linseed	[illegible]	[illegible]	1547d	629b	223d	37c	36.1c	1.34	7992
Barley + wheat	[illegible]	[illegible]	1513d	1051d	215d	35d	34.4d	1.28	5095

Any two means in a column not having a [illegible] differ significantly at 0.05 P (DMRT).

m ~of the main crop was reported by Prasad *et al.* (1988).

Number of Grains per Spike of Barley: Various intercrops had significant effect on grains per spike of barley (Table I). Wheat caused significantly more reduction in the grains per spike of barley than linseed and methra which were statistically equal to each other. TIle minimum reduction in grains per spike was. however, noted in lentil and gram intercropping systems.

IOOO-Grain Weight of Barley: Intercropping decreased 1000-grain weight of barley significantly (Table I). Wheat and linseed caused the maximum reduction in Iaaa-grain weight of barley due to their continuous exhaustive competition with barley. Legume intcrcrops had relatively less effect on 1000-grain weight probably due to mild competitive effects. These results are in consonance with those of Khan (1984) who reported that 1000-grain weight of wheat was adversely affected in different intercopping systems.

Land Equivalent Ratio and Net Income: Land equivalent ratio (LER) indicates the yield advantages of intercropping over monocropping. LER values showed 28 to 45 '}{ yield advantage of different intercropping systems over sole cropping of barley (Table I). The maximum yield advantage (45 %) was recorded in barley + lentil, followed by barley + gram (38 %), while the minimum (28 %) was in barley + methra and barley + wheat intercropping systems.

In terms of monetary gain, all the intercropping systems gave substantially more net income ha ı than that of the pure stand of barley. The maximum net income of Rs. 10367 ha ı was obtained from barley + lentil against the minimum of Rs. 6641 ha ı from the sole crop of barley. The results suggest that barley + lentil is the hest intcrcropping system in all respects. Higher yield advantage and net income ha ı in different intcrcropping systems has also been reported by Nazir *et al.* (1988). Mandal and Mahapatra (1989) and Abo-Shetaia (1990).

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