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B'O~EC,ONOMIC ASSESSMIW' OF DIFFERENT WHEAT~BASEO INTERCftOPPING SYSTEMS

M. Shaf Nazir,EhsenElahi, A. Jabbar, M. Saeed &, Riaz Ahmad
Department QfAtronomy, University of Agriculture, Faisalabad

Biological efficiency and ecoflomIC$ of different wheat-based intefcropping systems were determined on a sandy clay loam soil, at the University *of* Agriculture, Faisalabad. Intercropping systems comprised wheat + methra, wheat + lentil, wheat + gram, wheat + linseed, wheat + barley and sole wheat. Wheat was planted in 100 cm spaced 4-row strips with 20 cm space between the rows in a strip. Intercrops were sown between the wheat strips at the time (;)f planting wheat. Different yield components of wheat were invariably influenced significantly by the M80eiated *cultures.* Intercropping of rnstbra. lentil, gram, linseed and barley reduced wheat yield to the extent of 320, 326, 200, 520 and 706 kg ha', respectively. At the cost of this much reduction in wheat yiet.d, an additional harvest of 3.84, 270, 242, 347 and 699 kg ha' of the respective intercrops was obtained. All the intercropping systems except wheat + badey gave substantially higher total wheat yield equivalent than sole wheat (2491 kg ha"), being the maximum of3975 and 3515 kg ha' for wheat + methra and wheat + lentil, respectively. Similarly, in monetary terms, both the wheat-methra and Wheat-lentil intercropping systems proved to be more beneficial than other intercropping systems including the monocropped wheat.

Key words: biological and economic assessment, wheat-based intercropping

INTRODUCTION

At present, food production in Pakistan is inadequate and is getting worse day by day. Thus, there is a need for increased production of wheat, pulses and oilseedsas a whole in order to meet the diversified needs of the ever increasing population of the country. The area under these crops cannot be increased because of the inflexibility of the existing cropping patterns. Hence the only way to increase the productivity of these crops is to grow them in association with each other in such a pattern, that not only the productivity of the base crop is least affected by the associated cultures but also the production per unit area is enhanced.

The conventional methods of planting wheat in narrow rows do not permit intercropping in wheat. A new method of planting wheat in 100 cm spaced four-row strips without diminishing its plant population per unit area has been developed (Nazir *et al.,* 1986), which has made it possible to practise intercropping in wheat in independent strips without too much intercrop competition and interference. Besides, strip plantation facilitates intercroppinq and ensures more efficient and effective utilization of the land and water resources towards increased production per unit area and time (Ahrnad, 1990; Patrick *et al.,* 1995). The present study was, therefore, undertaken to determine the biological relationships of different legume and oilseed crops with wheat when grown in association with each other in independent strips at constant population density of wheat under the irrigated conditions at Faisalabad. Economic efficiency of intercropping was also worked out.

MATERIALS AND METHODS

Investigations into the feasibility and economics of intercropping methra *(Trigone//a foenugraecuml,* lentil(Lens *culinaris* Medic.), gram *tCtoer erietinum* L.), linseed *iLlnum usitatissimum* L.) and barley *(Hordeum vulgare* L.) in wheat were carried out at the University of Agriculture, Faisalabad on a sandy clay loam soil during the year 1990"91. The experiment was laid out in a randomized complete block design with three replications using a plot size of 4.8 x 5 m.

Wheat cultivar Pak..81 was planted on November 24, 1990 with a single row hand drill. The crop was sown on a well prepared seedbed in 100 cm spaced 4-row strips with a row to row distance of 20 cm within each strip (20/100 cm). The' intercrops were sown between the wheat strips maintaining a row to row distance of 25 cm. A basal dose of 100 kg Nand 100 kg P ha" in the form of urea and SSP, respectively was applied. The whole of P and half of N was incorporated in the soil at the time of seedbed preparation, while the remaining half of N was top-

dressed with first irrigation only, in the wheat strips. In all three irrigations excluding soaking irrigation (Rauni) were given to mature the crops. The crops were kept free of weeds by hand weeding from time to time.

Observations on the desired parameters of the component crops were recorded by using the standard procedures ..Land equivalent ratio (LER)was calculated by using the following formula:

$$LER = \frac{\text{Yield of crop a in intercropping system}}{\text{Yield of crop a in pure stand}} + \frac{\text{Yield of crop b in intercropping system}}{\text{Yield of crop b in pure stand}}$$

Wheat grain yield equivalent was computed by converting the yields of intercrops into the wheat grain yield based on the existing market price of various intercrops. The data collected were analysed statistically using the Fisher's analysis of variance technique and LSD test at 0.05 P was used to compare the treatment means (Steel and Torrie, 1981).

RESULTS AND DISCUSSION

Various intercrops affected the wheat biomass ha' differently (Table 1). Wheat intercropped with barley and linseed produced significantly less wheat biomass than wheat alone, whereas intercropping of methra, lentil and gram did not reduce wheat biomass ha' to a significant extent compared to sole wheat crop. Reduction in wheat biomass yield due to barley and linseed intercropping might be attributed to continuous exhaustive competition between the component crops. The same trend was observed in wheat grain yield ha' under the influence of different intercrops. Significant reduction in wheat grain yield was recorded when grown in association with barley or linseed, while the legume inter crops like methra, lentil and gram did not cause a significant reduction in wheat grain yield compared to monocropped wheat. Intercropping of methra, lentil, gram, linseed and barley decreased wheat grain yield by 320, 326, 200, 520 and 706 kg ha^{-1}. However, at the cost of this much reduction in wheat yield, an additional yield of 384, 270, 242, 347 and 699 kg ha' of the respective intercrops was obtained which compensated more than the losses in wheat production with the exception of barley intercrop.

Table 1. [illegible] well as intercrops yield, [illegible]

[illegible]	[illegible] (kg ha^{-1})	Grain	[illegible] (kg ha^{-1})	[illegible]	[illegible]	[illegible]	[illegible]	Total wheat yield equivalent (kg ha^{-1})	[illegible]
[illegible]	7376 a	2491	-	294 a	[illegible]	[illegible]	1.00	2491	[illegible]
[illegible] + [illegible]	6874 ab	2171	[illegible]	[illegible]	[illegible]	50.27 c	[illegible]	[illegible]	[illegible]
[illegible] + lentil	[illegible]	2165 ab	270	[illegible]	[illegible]	[illegible]	1.27	[illegible]	[illegible]
Wheat + gram	[illegible]	2291 a	242	244 c	[illegible]	49.57 c	1.29	2896	9710
Wheat + linseed	[illegible]	1973 bc	347	226 cd	[illegible]	47.03 d	1.17	2910	9447
Wheat + barley	5422 c	1785 c	699	199 d	[illegible]	[illegible]	1.15	2624	7430

Any two means in a column not sharing a letter differ significantly at 0.05 P (LSD).
Wheat yield equivalent of intercrops was calculated at the rates given below:
1 kg methra = 3.33 kg wheat; 1 kg lentil = 3.33 kg wheat; 1 kg gram = 3.[illegible]

Reduction in wheat grain and straw yields as a result of different legume and non-legume intercrops has also been reported by Tareen *et al.* /1988), Ahmad (1990) and Aslam (1990).

Fertile tillers m^{-2} differed significantly under the various intercropping systems'~>7' the intercrops except methra caused substantial reduction in number of fertile tillers m^2 compared to sole wheat. The maximum reduction was noted in wheat intercropped with barley and linseed which might be ascribed to the intensive competition between the component crops for essential factors because of their exhaustive nature. Such suppressive effects of different intercrops on number of fertile tillers m^{-2} were reported by Khan (1984),

Both the legume and *non-legume* intercrops reduced significantly the grains per spike compared to monocropped wheat. However, the maximum reduction was caused by barley and linseed intercropping which might be attributed to their simultaneous exhaustive competitive effects. These findings do not corroborate with those of Khan (1984) who reported that number of grains per spike of wheat was not affected significantly by linseed and mungbean intercropping. Similarly, 1000-grain weight of wheat was decreased significantly by all the intercrops under study with the maximum reduction caused by barley and linseed intercropping which might again be attributed to the exhaustive competitive effects of the respective associated crops. These results are in line with those of Khan (1984) who also reported suppressive effect of intercropping on 1000-grain weight of wheat.

The land equivalent ratio was observed to be more than one in all the intercropping treatments showing yield advantage over monocropping of wheat. The advantage of intercropping over sole wheat crop varied from 15 to 30% with the maximum /30%) for wheat-methra followed by wheat-gram /29%) and wheat-lentil /27%) against the minimum of 15 and 17% in case of wheat-barley and wheat-linseed intercropping systems, respectively.

In terms of total wheat yield equivalent, all the intercropping treatments yielded higher (2624 to 3450 kg ha^{-1}) than monocropped wheat (2491 kg ha^{-1}), being the highest for wheat + methra (3450 kg ha^{-1}), followed by wheat + lentil (3064 kg ha^{-1}). wheat + linseed (2910 kg ha^{-1}) and wheat + gram (2896 kg ha^{-1}) against the minimum of 2624 kg ha^{-1} for wheat + barley.

Regarding monetary gain: the highest net income of Rs. 12833 ha^{-1} was obtained from an intercropping system of wheat + rnethra, followed by wheat + linseed /Rs. 10339 ha^{-1}) which was substantially higher than from sole wheat (Rs. 8833 ha^{-1}) against the minimum of Rs. 7430 ha^{-1} for wheat + barley. Higher yield advantage and net income ha^{-1} in different intercropping systems has also been reported by Gupta and Pradhan (1988).

The results led to the conclusion that wheat-methra and wheat-lentil intercropping in independent multi-row strips appeared to be highly productive and profitable compared to monocropping of each of the component crops.

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