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Crop Productivity and Economics of Wheat-methra Intercropping in Different Wheat-strip Arrangements under Irrigated Conditions

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Abstract: Intercropping of methra between 4-, 6-, 8- and 10-row strips of wheat decreased wheat grain yield by 26.92, 22.98, 18.96 and 15.48% respectively compared to wheat alone. However, at the cost of this much reduction in wheat grain yield, additional harvests of 740, 549.5, 382 and 241.5 kg ha^{-1} of methra from 4-, 6-, 8- and 10-row wheat strips, respectively, were obtained which compensated more than the losses in wheat production. Among the various wheat-methra intercropping systems, the highest net income of Rs. 19463 ha ^{1} with benefit cost ratio of 5.10 was obtained from wheat grown in 100 cm-spaced 4 cm-row strips + 3 rows of methra, while minimum net income of Rs. 11723 ha^{-1} with benefit cost ratio of 3.78 from sole cropping of methra.

Key words: Wheat-methra intercropping, crop productivity, net income, benefit-cost ratio, wheat yield equivalent, net income

Introduction

In view of increasing interest in intercropping due to small holding and diversified needs of small farmers in Pakistan, it is imperative to develop a suitable intercropping technology leading to increased production of the component crops per unit area. Among various grain legumes, methra (*Trigonella foenugraecum* L.) is valuable "rabi" legume, which fixes atmospheric nitrogen in soil. It is drought resistant and grown both as fodder and seed crops. When green, it is used as vegetable and fodder while its seed is used in the pre'paration of medicine, pickles and in horse-conditioning powder. Methra being a rabi crop, competes with wheat (*Triticurn aestivum* L.) for area. However, wheat is the most important staple food of the people in Pakistan. Consequently we can not take risk of decreasing area under this crop. Under such circumstances, area under rabi grain-legumes such as methra can not be increased because of their competition with wheat. Therefore, one of the ways to increase production of methra is to grow it in association with wheat.

Intercropping has been reported to have either no effect (Prasad *et al*., 1988; Hiremath *et al*., 1990) or negative impact (Grewal *et al*., 1983; Ahlawa *et al*., 1985; Autkar *et al*., 1991; Nazir *et al*., 1997) on wheat grain yield. Reduction in grain yield of wheat due to different intercrops has been ascribed to a decrease in number of fertile tillers per unit area (Sahi, 1988; Bajwa *et al*., 1992), grain weight per spike (Khan, 1986; Bajwa *et al*., 1992) and 1000-grain weight (khan, 1986; Bajwa *et al*., 1992). However, such losses in wheat production are compensated by the additional harvest of intercrops (Nazir *et al*., 1988). Moreover, better land utilization, as indicated by higher total wheat yield equivalent per unit area (Bajwa *et al*., 1992) and land equivalent ratio (Riaz, 1991; Patrick *et al*., 1995), greater benefit cost ratio (Bajwa *et al*., 1992) and higher net benefit (Ali, 1989; Bajwa *et al*., 1992) are achieved through intercropping.

Conventional method of planting wheat in single rows, however, does not permit convenient and systematic intercropping because of narrow row spacing. Therefore, a new method of planting wheat in well spaced multiple-row strips without decreasing its plant population has been evolved (Nazir *et al*., 1988) which has made it feasible to practice intercropping in wheat without too much intercrop competition. Present study was, therefore, undertaken to determine agro-economic relationships of component crops in wheat-methra intercropping system with different wheat-strip arrangements under irrigated conditions of Faisalabad.

Materials and Methods

Agro-economic relationships of component crops in wheatmethra intercropping under different wheat-strip arrangements were studied during the rabi season, 1992-93 on a loam soil under field conditions at Faisalabad.

The experiment was laid out in a Randomized Complete Block Design with four replications. Net plot size varied among various treatments to accommodate planting of the component crops. However, the same area was harvested from each treatment to compare yields of the component crops and economics of various intercropping systems. Treatments were wheat alone in 30 cm apart single rows, methra alone in 30 cm apart single rows, wheat in 100 cm apart 4-, 6-, 8- and 10-rows strips. Distance among the rows of each wheat strip was 15 cm. Strip-planted wheat cv. Pak-81 was intercropped with methra (Local selection). In each strip-planting system of wheat, three 30-cm spaced rows of methra were sown in space between the strips of wheat.

Wheat and methra were sown using seed rates of 100 and 40 kg ha^{-1}, respectively. Both the crops were sown on November 25 1992. A basal dose of 100 kg P_2O_5 ha^{-1} was applied to all treatments at the time of seed bed preparation. Nitrogen was applied at 100 kg ha^{-1}, half at sowing and half with first irrigation. In all four irrigations each of 7.5 cm were applied. All the agronomic practices except under investigation kept normal and uniform for all the treatments.

Data were recorded on wheat parameters like number of fertile tillers per unit area, number of grains spike^{-1}, weight of grains spike^{-1}, 1000-grain weight and grain yield while in methra only seed yield was recorded. Standard procedures were followed to collect the data. Benefit-cost ratio (BCR) was determined by using the following formula.

$$\text{BCR} = \text{Gross income (Rs. ha}^{-1}\text{)/Gross expenditure (Rs. ha}^{-1}\text{)}$$

Wheat grain-yield equivalent was computed by converting the yield of intercrop, 1.e., methra into the yield of wheat based on existing market price of individual crop' produce (Anjeneyulu *et al*., 1982). The data collected were statistically analysed using the MSTAT C computer programme.

Results and Discussion

Wheat yield and yield components: Data regarding wheat yield and its components as well as seed yield of methra are presented in Table 1.

Table 1: Yield and yield components of wheat and seed yield of methra as affected by wheat-methra intercropping in different wheat strip arrangements

Treatments	No. of fertile tillers (m^{-2})	No. of grains spike^{-1}	Wt. of grains spike^{-1}	100 grain weight (g)	Seed yield (kg ha^{-1})	
					Wheat	Methra
Wheat alone in 30 cm spaced single rows	291.73 a	43.8 NS	2.89 a	52.5 a	4282 a	-
Methra alone in 30 cm spaced single rows	-	-	-	-	-	1247.5 a
Wheat in 100 cm spaced 4-row strips+methra	189.25 e	42.2	1.38 e	40.2 d	3129 e	740.0 b (40.68)
Wheat in 100 cm spaced 6-row strips+methra	236.34 d	41.9	1.81 d	40.6 d	3298 d	549.5 c (55.95)
Wheat in 100 cm spaced 8-row strips+methra	252.25 c	43.8	2.09 c	44.5 c	3470 c	382.0 d (69.78)
Wheat in 100 cm spaced 10-row strips+methra	267.60 b	44.1	2.38 b	48.7 b	3619 b	241.5 e (80.64)

Means not sharing the same letter in a column differ significantly from one another at p = 0.05.
NS = Non-significant () = % decrease compared with monocropping

Table 2: Economic analysis and total wheat-grain yield equivalent of wheat-methra intercropping under different wheat strip arrangements

Treatment	Gross income (Rs. ha^{-1})	Gross expenditure (Rs. ha^{-1})	Net income (Rs. ha^{-1})	Benefit cost ratio (BCR)	Total wheat grain yield equivalent (kg ha^{-1})
Wheat alone in 30 cm spaced single rows	20035	5207	14828	3.85	4282 (-)
Methra alone in 30 cm spaced single rows	15941	4218	11723	3.78	4603 (6.97)
Wheat in 100 cm spaced 4-row strips+methra	24215	4752	19463	5.10	5860 (26.93)
Wheat in 100 cm spaced 6-row strips+methra	22645	4712	17723	4.82	5325 (19.59)
Wheat in 100 cm spaced 8-row strips+methra	21262	4966	16296	4.29	4880 (13.97)
Wheat in 100 cm spaced 10-row strips+methra	19961	4996	14965	4.00	4510 (5.06)

() = Per cent increase over wheat alone.
A = Both seed and straw/stover yields were used to calculate BCR
B = Seed yield of both wheat and methra were used to calculate
C = Price (Rs. kg^{-1})
Wheat 2. Methra
a) Seed = 4.05 b) Straw = 0.50 a) Seed = 12 b) Stover 0.25 =

Number of fertile tillers m^2: Intercropping of methra under different wheat strip arrangements decreased significantly the number of fertile tillers m^{-2} of wheat at harvest. Wheat alone grown in 30-cm spaced single rows produced the maximum number of fertile tillers m^{-2} followed by 10-. 8-, 6- and 4-row strip planting patterns of wheat, respectively, which also differed significantly from one another. Similarly Mushtaq (1988) and Sahi (1988) stated that there was a significant decrease in the number of fertile tiller of wheat per unit area with different intercrops.

Number of grains per spike: Various wheat-methra intercropping patterns showed non-significant differences in number of grains per spike. These results suggest that intercropping methra in different wheat-strip arrangements did not have any effect on number of grains per spike of wheat compared to sole wheat. Non-significant differences in number of grains per spike of wheat grown in association with different legume and non-legume crops have been reported by Bajwa *et al*. (1992).

Grain weight per spike: Grain weight per spike was reduced significantly by various wheat-methra interecropping patterns compared to sole cropping of wheat. Intercropping methra in wheat grown in 10-, 8-, 6- and 4-row strips reduced grain weight spike^{-1} by 17.65, 27.68, 37.37 and 52.25%, respectively against wheat alone. Differences among the latter wheat-methra intercropping patterns were also found significant. These results are in accordance with the findings of Khan (1986) and Mushtaq (1988) who reported that grain weight spike^{-1} of wheat was affected significantly by different wheat-based intercropping systems.

1000-grain weight: There were significant differences in 1000-grain weight among different wheat-methra intercropping patterns. Sole wheat gave significantly higher 1000-grain weight than the intercropped wheat grown in 10-, 8-, 6- and 4-row strips. The latter intercropping patterns decreased 1000-grain weight of wheat by 7.24, 15.24, 22.67 and 23.43%, respectively, compared to sole wheat. Khan (1986) also reported significant decrease in 1000-grain weight of wheat in different wheat intercropping systems.

Grain yield: Differences in grain yield of wheat produced by various intercropping patterns were significant. The highest grain yield (4282 kg ha^{-1}) was obtained from sole wheat compared to 3129, 3298, 3470 and 3619 kg ha^{-1} from 4-, 6-, 8- and 10-row strips of wheat respectively, each intercropped with methra. Overall, intercropping methra in 4-, 6-, 8- and 10-row strips of wheat reduced wheat grain yield by 26.92, 22.98, 18.96 and 15.48%. respectively. These results further indicated that an increase in the size of wheat strips resulted in corresponding decrease in grain yield. These results are quite in agreement with those of Grewal *et al*. (1983), Ahlawa *et al*. (1985), Tareen *et al*. (1988), Autkar *et al*. (1991), Nazir *et al*. (1997) and Ahmed *et al*. (1998) who reported significant reduction in wheat yield as a result of intercropping.

Seed yield of methra: Intercropping methra in wheat significantly reduced methra seed yield compared to sole methra. Wheat raised in 4-, 6-, 8- and 10-row strips decreased the intercropped methra yield by 40.68, 55.95, 69.38 and 80.64%, respectively. All wheat-methra intercropping systems significantly differed from one another. A reduction of 63 per cent in seed yield of methra due to associated wheat has been reported by Kundi (1991).

Economic analysis: Different wheat-methra intercropping patterns were compared for their profitability on the basis of net income, benefit-cost ratio (SCR) and total wheat yield equivalent (Table 2).

Net income: All wheat-methra intercropping patterns gave higher net income ha^{-1} than monocropping of wheat or methra. Among various systems of wheat-methra intercropping, the highest net income of Rs. 19463 ha^{-1} was obtained from wheat grown in 4-row strips + methra against the lowest of Rs. 11723 ha^{-1} from methra alone. All wheat-methra intercropping patterns exhibited higher benefit cost ratio (8CR) than that of sole wheat or methra. The maximum BCR of 5.10 was recorded in 100 cm spaced 4-row strips of wheat + methra, followed by the intercropped wheat grown in 6-, 8- and 10-row strips, respectively. Nazir *et al*. (1997) also reported that net income was more when wheat was grown in association with other crops than that of the monocropped wheat.

Wheat-grain yield equivalent: Wheat grain yield equivalent of all the wheat-methra intercropping systems was greater than monocropped wheat. The greatest wheat-yield equivalent of 5860 kg ha^{-1} was obtained from wheat grown in 100 cm spaced 4-row strips + methra against 5325, 4880 and 4510 in 6-, 8- and 10-row strips of wheat, respectively, each intercropped with methra. By contrast, the lowest wheat yield equivalent of 4282 kg ha^{-1} was produced by sole wheat. It means that methra intercropping in wheat grown in 4-, 6-, 8- and 10-row strips increased wheat yield equivalent by 26.93, 19.59, 13.97 and 5.06 %, respectively over sole cropping of wheat. Similarly monocropped methra gave 6.97% greater wheat yield equivalent than monocropped wheat. Ahmad and Saeed (1998) also reported considerable increase in wheat grain yield equivalent due to intercropping.

Above economic comparison based on net income ha^{-1}, BCH and wheat yield equivalent suggests that intercropping 3 rows of methra in 100 cm spaced 4-row Strips of wheat is the most profitable wheat-methra intercropping pattern followed by 6-, 8- and 10-row wheat strips + methra, respectively.

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