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RESEARCH ARTICLE

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Intercropping of *Rabi* maize (*Zea mays* L.) with oilseed, pulses and spice crop

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ABSTRACT

An experiment was conducted at Kanpur, during *Rabi* 2006-07 to assess the performance of maize in intercropping with oilseed, pulses and spice crops. The result revealed that intercropping association of maize and fenugreek in 1:2 row ratio produced significantly higher harvest index and maize equivalent yield (38.80% and 83.96 q ha^{-1}, respectively) than rest of the intercropping systems and also maize alone except maize + field pea + fenugreek and maize + vegetable pea + fenugreek tried in 1:1:1 row proportion. Maize + fenugreek (1:2) intercropping system produced significantly highest net returns (Rs. 36666 q ha^{-1}) as well as higher B:C ratio (2.48) than other intercropping systems tested and maize alone also.

KEY WORDS : Intercropping, Maize equivalent yield, Fenugreek, Vegetable pea

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INTRODUCTION

Maize is regarded as most important cereal crop in the world; particularly on account of the many uses it is put to. The percentage of distribution of maize under various uses (animal feed 10%, human food 85% and waste 5%) conclusively proves the superiority of this cereal crop over rests. There is no any cultivated cereal which has so immense potentiality as miracle crop maize possess thus commonly called Queen of cereals.

Maize is better in nutrition after wheat. Maize grain contains about 10% protein, 4% Oil, 70% carbohydrate, 2-3% crude fiber, 10.4% albuminoides, 1-4% ash. Maize protein zein is deficient in tryptophane and lysine, the two essential amino acids. Besides this, maize grain contains significant quantities of vit 'A', nicotine acid, riboflavin and vitamin 'E'. Maize is low in calcium, fairy high in phosphorus.

Maize has immense potential not only in *Kharif* but equally in winter and spring season also. A separate winter maize programme started in 1975 realizing its potential in all non temperate areas of the country. *Rabi* maize on an average yield 1 to 5 times higher than rainy season maize. The winter maize favourably responds to better crop management (Singh, 1998). Sustainable crop production from limited land resources is the key concern in this millennium. According to an estimate, India will requires 420 million tonnes food grain to meet the in increasing food needs by the year 2020. The only option available is to increase production by crop intensification by increasing the input use efficiency.

Among various approaches, intercropping is one of them which provide an opportunity to increase the production and productivity of the cereals particularly maize. Advantages of legume intercropped with cereal have been highlighted by Aiyer (1949). Growing oilseeds, pulses, legume and spice crops in wider row spacing is beneficial to the marginal farmers. Physical area under cultivation cannot be enhanced, thus the only way is to increase the productivity per unit area and per unit time. This can be achieved by raising more crops in a year through multiple, relay and inter cropping by utilizing the available resources more efficiently. Considering these views, present investigation was carried out.

MATERIALS AND METHODS

A field experiment was conducted during *Rabi* season of 2006-07 at Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (India). The experiment was carried out in Randomized Block Design with twelve treatments

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replicated three times. *viz.,* maize alone, maize + linseed (1:2), maize + vegetable pea (1:2), maize + field Pea (1:2), maize + fenugreek (1:2), maize + linseed + fenugreek (1:1:1), maize + field pea + fenugreek (1:1:1), maize + vegetable pea + fenugreek (1:1:1) , linseed alone , field pea alone , vegetable pea alone, fenugreek alone. The sole crop of winter maize and intercropping of maize + fenugreek, maize + vegetable pea, maize + linseed, maize + field pea and maize + linseed + fenugreek, maize + vegetable pea + fenugreek, maize + field pea + fenugreek were fertilized 150:75:50 N:P:K, kg ha^{-1} as basal dressing through urea, DAP and MOP. Any additional nutrients were not applied to the intercrops. All recommended cultural practices were followed for maize and intercrops. Observations were recorded and statistically analyzed by the standard methods.

RESULTS AND DISCUSSION

The data presented in Table 1 revealed that the significantly highest maize plant height (203.13 cm) and dry matter at harvest (310.53 g/plant) was recorded in the treatment maize alone. All intercrops significantly lowered maize plant height as well as dry matter at harvest. Similar results were noticed by Singh *et al.*(2000) and Mishra *et al.* (2001). Maize alone also recorded significantly highest cobs/plant, cob length and test weight (1.67, 14.88cm and 26.76 g, respectively) than other intercropping treatments, while it was followed by maize + fenugreek (1:2) (1.52, 13.56 cm and 24.37 g, respectively). Maize alone also recorded significantly higher cob weight (138.60 g) and grain weight/cob (103.68 g) but was at par with maize + fenugreek (1:2) (135.45 and 97.67 g, respectively) and maize + field pea (1:2) (134.67 and 96.45 g, respectively).

The data presented in Table 2 revealed that maize alone produced significantly higher biological yield (111.55 q ha^{-1}) followed by maize + field pea (1:2) (105.99 q ha^{-1})

Table 1 : Growth and yield attributes of *Rabi* maize *viz*., plant height, dry matter at harvest, cobs/plant, length of cob, weight of cob, grain weight /cob and 100 grain weight as influenced by various intercropping treatments

Treatments	Plant height (cm) at harvest	Dry matter at harvest	Cobs/ plant	Cob length (cm)	Cob weight (g)	Grain weight / cob (g)	100-grain weight
Maize alone	203.13	310.53	1.67	14.88	138.60	103.68	26.76
Maize + Linseed (1:2)	179.65	274.60	1.47	13.12	129.60	90.28	23.56
Maize + Vegetable pea (1:2)	181.67	277.61	1.48	13.23	132.09	94.20	23.72
Maize + Field pea (1:2)	182.63	279.30	1.51	13.42	134.67	96.45	24.20
Maize + Fenugreek (1:2)	185.03	282.82	1.52	13.56	135.45	97.67	24.37
Maize + Linseed + Fenugreek (1:1:1)	177.10	270.69	1.44	12.98	116.27	83.18	23.06
Maize + Field pea + Fenugreek (1:1:1)	178.78	273.29	1.47	13.13	128.04	89.12	23.56
Maize + Vegetable pea + Fenugreek (1:1:1)	178.05	272.21	1.45	13.04	126.78	86.17	23.25
Mean	183.25	280.13	1.50	13.42	130.43	92.69	24.06
S.E. ±	4.82	9.45	0.05	0.41	3.43	4.14	0.70
C.D. (P = 0.05)	10.34	0.12		0.89	7.35	8.88	1.50

Table 2 : Biological yield, harvest index, grain yield of maize and intercrops and maize equivalent yield as influenced by various intercropping treatments

Treatments	Biological yield of maize (q ha^{-1})	Harvest index (%)	Grain yield of maize and intercrops (q ha^{-1})	Maize equivalent yield of system (q ha^{-1})
Maize alone	111.55	37.98	42.30	42.30
Maize + Linseed (1:2)	98.76	34.57	34.14 (8.54)	64.63
Maize + Vegetable pea (1:2)	99.26	37.76	37.48 (9.21)	65.29
Maize + Field pea (1:2)	105.99	36.67	38.87 (9.44)	67.36
Maize + Fenugreek (1:2)	104.30	38.80	40.47 (10.57)	83.96
Maize + Linseed + Fenugreek (1:1:1)	99.07	35.48	35.15 (6.27, 4.56)	77.24
Maize + Field pea + Fenugreek (1:1:1)	99.81	36.90	36.83 (6.80, 6.54)	82.78
Maize + Vegetable pea + Fenugreek (1:1:1)	98.02	36.85	36.12 (6.42, 6.18)	79.53
Mean	102.09	36.87	37.67	7.38
S.E. ±	2.32	0.91	1.84	2.21
C.D. (P = 0.05)	4.97	1.95	3.94	4.73

Table 3: Economics of the intercropping system as influenced by the different treatments

Treatments	Gross monetary returns (Rs./ha)	Cost of cultivation (Rs./ha)	Net monetary returns (Rs./ha)	B : C Ratio
Maize alone	30879	20857	10022	1.48
Maize + Linseed (1:2)	47126	25074	22052	1.87
Maize + Vegetable pea (1:2)	47180	24996	22183	1.89
Maize + Field pea (1:2)	47661	24603	23058	1.93
Maize + Fenugreek (1:2)	61290	24623	36666	2.48
Maize + Linseed + Fenugreek (1:1:1)	56285	24548	29836	2.12
Maize + Field pea + Fenugreek (1:1:1)	60429	26921	33507	2.25
Maize + Vegetable pea + Fenugreek (1:1:1)	58056	26558	31498	2.18
Mean	51128	-	26105	2.02
S.E. ±	1357.09	-	1030.99	0.12
C.D. (P = 0.05)	2910.67	-	2211.26	0.25

and maize + fenugreek (1:2) (104.30 q ha^{-1}). Maize + fenugreek (1:2) registered significantly higher harvest index (38.80) but was at par with maize alone (37.98), maize + vegetable pea (1:2) (37.76), maize + field pea + fenugreek (1:1:1) (36.90) and maize + vegetable pea + fenugreek (1:1:1) (36.85). Maize alone produced significantly higher grain yield (42.30 q ha^{-1}) and was at par with maize + fenugreek (1:2) (40.47 q ha^{-1}) and maize + field pea (1:2) (38.87 q ha^{-1}). Further maize equivalent yield obtained due to maize + fenugreek (1:2) (83.96 q ha^{-1}) was significantly higher than other intercropping combinations tested except maize + field pea + fenugreek (1:1:1) (82.78 q ha^{-1}) and maize + vegetable pea + fenugreek (1:1:1) (79.53 q ha^{-1}). The results are in conformity with Singh and Kumar (2002).

The data from Table 3 postulated that maize + fenugreek (1:2) gave significantly higher gross monetary returns (Rs. 61290 ha^{-1} and 2.48) and was at par with maize + field pea + fenugreek (1:1:1) (Rs. 60420 ha^{-1} and 2.25, respectively). Maize + fenugreek (1:2) gave significantly highest net monetary returns (Rs. 36666 ha^{-1}) than rest of intercropping treatments. Similar trend was reported by Mishra *et al.* (2001).

Thus it can be inferred that for productivity increment and higher economic benefits instead of maize alone intercropping systems *i.e.* either maize + fenugreek (1:2) or maize + fenugreek (1:1:1) should be planted.

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