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Yield and Economics as Influenced by Winter Maize (*Zea mays* L.) Based Intercropping System in Eastern Uttar Pradesh

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Abstract

A field experiment was conducted during winter (*rabi*) season of 2005 and 2006 to evaluate yield and economics of winter maize (*Zea mays* L.) based intercropping system under different planting pattern. Maize grown with four intercropping association namely lentil (T_2), coriander (T_3), lentil + coriander (T_4) along with the sole maize (T_1) crop in randomized block design with four replications. The result of the experiment showed that biological, grain and stover yield of maize were maximum and significantly higher in sole maize (T_1) crop followed by maize + lentil (T_2) and maize + coriander (T_3) and minimum values of these parameter were recorded under maize + lentil + coriander (T_4) system. Higher row spacing of maize plant also reduced significantly grain, biological and stover yield. However, among various maize based intercropping system maize + lentil + coriander (T_4) were found to be significantly higher gross return and net return of Rs 44,387 and Rs 17,399.00 respectively followed by maize + lentil (T_2) and lowest gross return and B : C ratio were recorded under sole maize (T_1) alone.

Key words : Intercropping, Winter maize, Yield, Maize equivalent yield, Economics.

In easten Uttar Pradesh maize has become a well adopted with high yield potential (40—60 q/ha) and the area with the crop has increased tremendously. There is ample scope to utilize the vacant wider inter-row spaces of maize during the initial slow growth period of the crop by introducing some compatible crop and adjusting the crop geometry for increased productivity (1). A very few studies have actually considered the response of component crops in determining yield and economics as influenced by winter maize (*Zea mays* L.) based intercropping system. Therefore, to assess yield and economics of different planting pattern, the present study was undertaken.

Methods

The field experiment was conducted during the winter season of 2005-06 and 2006-07 at Agronomy Research farm, CSAUA & T, Kanpur. The treatment consisted of four intercropping system namely maize alone T_1, maize + lentil T_2 (1:2), maize + coriander T_3 (1 : 2) and maize + lentil + coriander T_4 (1:1:1) with spacing of 60 cm and 70 cm in factorial randomized block design with four replications. The sole crop of maize and intercropping association of lentil and coriander were sown on 21 November, 2005. Maize was sown at two different rows spacing i.e. 60 cm and 70 cm. Spacing between plant to plant distance was kept at 20 cm apart in both. The soil was sandy loam in texture, low in organic carbon (0.49%), slightly alkaline (7.4 pH) in reaction, low in available N (128.8 kg/ha), medium in available P (19.7 kg/ha) and K (738 kg/ha). A fertilizer schedule of 175 : 75 : 50 kg/ha was applied to all the treatments through DAP and MOP. Whole amount of phosphorus and potash and half dose of nitrogen were applied as basal and rest dose of N were applied as top dressed in two different growth stages i.e. first at knee high stage and second at pre-tasseling stage. No additional nutrients were applied to the intercrop. Lentil and coriander were intercropped with maize crop in additive series. In one treatment two rows of lentil were sown between tow rows of maize at 60 cm spacing of maize and 70 cm spacing. In other treatment, one row of lentil and one row of coriander were sown between two rows of maize at both the spacing and one another treatment two rows of coriander were sown in between two rows of maize in both spacing. Thinning was done to maintain optimum plant density at 15 and 25 DAS, respectively. Interculture op-

Table 1. Yield of winter maize as affected by different treatments (mean of two years).

Treatments	Biological yield (q/ha)	Grain yield (q/ha)	Stover yield (q/ha)	Harvest Index (%)
Maize alone (T_1)	115.10	43.92	71.54	39.68
Maize + lentil (T_2)	97.98	37.97	59.14	38.87
Maize + coriander (T_3)	96.48	32.53	61.95	35.48
Maize + lentil + coriander (T_4)	87.25	30.93	56.75	5.48
SE ±	3.24	1.26	1.22	0.79
CD (P=0.05)	6.73	2.62	2.55	1.66

eration carried out with khurpi at 30 DAS to make the field with less weed infestation.

Results and Discussion

Effects on Yield Parameters

It was evident that sole maize crop treatment produced significantly higher grain and biological yield of winter maize over the other intercropping associations. Maize + lentil and maize + coriander intercropping system also differed significantly from each other and recorded less biological and grain yield compared to the sole maize crop treatment (Table 1). The over all development in growth and yield attributes of winter maize in sole cropping might be due to the better nutritional and free environment leading to increased photosynthetic efficiency and translocation of photosynthates towards sink (cobs). These result are in conformity with those of Karim et al. (2) who obtained highest yield from pure stand of maize and potato than maize + potato in combination. Prasad and Prasad (3) reported less coverage of grain yield of winter maize (4.71 tonnes/ha) when intercropped with coriander (4.98 tonnes/ha). Investigation on spacing showed that 60 cm spacing recorded significantly higher grain yield of 7.82 q/ha or 23.92% over 70 cm spaced maize crop. This result is similar to Sawhney et al. (4) who reported that for sown crop best result was obtained by seeding the crop on southern slopes of coast west ridges, spaced 60 cm apart with plant to plant spacing of 20 cm. In northern India, inter-row and intra-row spacing recommended for higher grain yield realization in 60 × 20 cm (5). The maize equivalent yield and different inter-cropping systems were significantly influenced among themselves as evident from the data presented (Table 2). Under sole winter maize treatment maize equivalent yield decreased significantly over maize based inter-cropping association viz. maize + lentil, maize + lentil + coriander and maize + coriander. The similar findings were reported by Prasad and Prasad (6) who recorded significant higher maize equivalent yield of three intercropped stands viz. coriander, mustard and raddish as 7.24—7.59 tonnes/ha than of maize in pure stands (4.98 tonnes/ha). Mishra et al. (7) also reported highest mean maize equivalent yield of 104.3 q/ha when maize was intercropped with lentil. Maize equivalent yield at 60 cm spacing increased significantly by 7.73 q/ha over 70 cm spacing but the performance of 70 cm is better over 60 cm due to better performance of intercrops which may be due to higher area, nutrient and sunlight available to crops. All the intercropping system gave higher gross and net returns than sole cropping of maize. The increase in gross returns was to the magnitude of Rs 18,056/ha in maize + lentil + coriander, Rs 12,008 in maize + coriander and Rs 8,986 maize + lentil intercropping system over sole *rabi* maize. Similarly, the increment in net return was Rs 11,398/ha and Rs 10,952/ha over sole maize respectively. Similar results were reported by Singh et al. (1)

Table 2. Grain yield and maize equivalent yield of intercrops under intercropping system and maize equivalent yield. (Mean of two years).

Treatments	Yield of lentil (q/ha)	Maize equivalent yield of lentil (q/ha)	Yield of coriander (q/ha)	Maize equivalent yield of coriander (q/ha)	Maize equivalent yield (q/ha)
Maize alone (T_1)	–	–	–	–	43.92
Maize + Lentil (T_2)	9.4	28.02	–	–	60.73
Maize + Coriander (T_3)	–	–	4.38	23.38	56.7
Maize + Lentil + coriander (T_4)	8.14	24.44	3.49	18.63	73.79
SE ±	0.40259	1.20776	0.21363	1.13371	1.92090
CD (P = 0.05)	0.91071	2.73213	0.48327	2.56463	3.99473

Table 3. Economics of the winter maize-based intercropping system as influenced by different treatment. (mean of two years).

Treatments	Cost of culti-vation (Rs/ha)	Gross monetary return (Rs/ha)	Net monetary return (Rs/ha)	B : C ratio (Re/Rs)
Maize alone (T_1)	23026	26355	6029	1.28
Maize + Lentil (T_2)	22727	35341.25	14208	1.47
Maize + Coriander (T_3)	22513	38363.75	13725.25	1.47
Maize + Lentil + coriander (T_4)	26988	44411.62	17427	1.64
SEd ±	–	856.69	1051.11	0.045
CD (P = 0.05)	–	1781.58	2185.91	0.09

who reported that maize + lentil fetched maximum monetary returns followed by maize + lentil system, whereas lowest net return was obtained by maize + potato intercropping system. Contrary to this, Sidhu et al. (8) reported minimum net return under maize + lentil, maize + coriander and maize + pea intercropping system. All the intercropping systems showed superiority over sole cropping of maize. Maximum maize equivalent yield (73.79 q/ha) was recorded under maize + lentil + coriander followed by maize + lentil (60.73 q/ha) intercropping system, which was significantly different from each other and significantly superior over sole maize treatment. Higher maize equivalent yield under intercropping pattern of maize + lentil + coriander and maize + lentil might be due to the better utilization of resources and balanced competition between component species and better market prices of intercrops contributed to higher maize equivalent yield. These results are in conformity with the findings of Mishra et al. (7), who reported higher maize equivalent yield under maize + coriander and maize + lentil inter cropping system.

Effects on Economics

Since the end product of intercropping systems are different, therefore, the conclusion is to be made in terms of maize equivalent yield and net monetary return obtained from the different system in total. The results on grain yield in terms of maize equivalent yield (Table 3) revealed that maize + lentil + coriander intercropping system fetched highest net return (Rs 17,399/ha) followed by maize + lentil (Rs 16,978/ha) which were higher over the sole maize cropping because of higher total productivity of maize crop and higher worked price of the companion corps. Induction of lentil and coriander as an intercrop with winter maize is more profitable and stable compared to maize sole. The findings are in close conformity with the result reported by Suman (9). Increment in maize equivalent yield at 70 cm is significant over crop at 60 cm, it may be due to higher space required to grow vigorously for intercrops like lentil and coriander where they can avoided nutrients and sunlight from large foliage area available at 70 cm spacing. Intercropping of lentil with *rabi* maize registered higher B:C (Table 3) followed by maize + lentil + coriander. Maize + lentil recorded B:C ratio of 1.74 which was significantly higher followed by maize + lentil + coriander (1.64) which is also significantly superior over sole maize (1.29). The results find support from the work of Patra et al. (10).

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