



Performance of chickpea (*Cicer arietinum*) and mustard (*Brassica campestris*) as a mixed crop in the coastal region of Bangladesh

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Abstract

On-Farm experimental trial were conducted on the field of Multi Location Testing (MLT) site at Amtali, Borguna and Farming System Research & Development (FSRD) site Razakhali, Dumki, Patuakhali during the Rabi season of 2014-2015. The experiment was laid out in RCB design with six treatments i.e. T₁: Chickpea 100%, T₂: 100% Mustard, T₃: 100% chickpea + 15% Mustard, T₄: 100% chickpea + 20% Mustard, T₅: 100% chickpea + 25% Mustard, T₆: 100% chickpea + 30% Mustard were used in the trial. In this trial *campestris* group of mustard & high yielding Chickpea varieties was used. Results revealed that the yield of chickpea decreased with the increase of mustard population in the mixed cropped situation in both the locations. At Razakhali, the highest Chickpea Equivalent yield (1730 kg/ha) was recorded from T₃: 100% chickpea + 15% Mustard treatment followed by T₄: 100% chickpea + 20% Mustard (1640 kg/ha). The highest gross margin Tk. 44260 and lowest gross margin Tk. 14270 was also obtained from T₃ and T₁ respectively. At Amtali location the highest Chickpea Equivalent yield (1575 kg/ha) was observed from treatment T₃: 100% chickpea + 15% Mustard followed by T₄: 100% Mustard (1480 kg/ha). Accordingly the highest gross margin Tk. 35180 and lowest gross margin Tk. 15070 was obtained from T₃ and T₁ respectively. The height BCR 1.74 & 1.59 was also found from T₃ treatment in both the locations respectively. From the result of this on farm trial it is apparent that, mixed cropping is more profitable than the sole cropping and risk of cultivation of one crop can be reduced by mixed cropping.

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Introduction

Bangladesh has suitable agro-ecological conditions for production of a number of pulse and oilseed crop species. However, since independence of Bangladesh (1971) to current date there is continuous decline in acreage and total production of pulses and oilseeds except some exceptional years. With removal or reduction of the yield gaps of different crop species and with emphasis on the increase production of nutrient enrich crops like pulses and oilseeds can increase the income level of the poor farmers, and thus, can ensure reduction of poverty at grass root-level with increase nutritional food security at local levels (Rahman and Zilani, 2009). Food legumes, particularly pulses, play a significant role in rain fed agriculture and in Bangladeshi diets. They occupy the second largest cropped area after rice in the country (6.2% of the total cropped area) (BBS, 2013; 2014). The excellent nutrition value of pulses is highly complementary to a cereals based diet in developing countries. Pulses are a cheaper source of proteins than animal foods (Singh and Jambunathan, 1989). Among pulses chickpea is one of the most important grain legumes traditionally cultivated in deprived areas and saline soils.

The agronomical importance of chickpea (*Cicer arietinum* L.) is based on its high protein concentration 25.3–28.9% for the human and animal diet, being used more and more as an alternative protein source. On the other hand, mustard (*Brassica spp.*) is an important oil crop, which also ranks first position among the oil crops in Bangladesh (BBS, 2014). In recent year department of agricultural extension (DAE) and ministry of agriculture have considered pulses and oilseed as a high priority sub-sector and have taken a plan titled “Pulses and Oil Crops Research and Development Vision: 2030” to increase the oilseed and pulse production. To fulfill the increasing demand of the country, it is necessary to increase the production of these two important cereal crops: pulses as well as oil seeds. The area of Chickpea cultivation in the country is decreasing day by day because of poor yield. Both Chickpea and Mustard are cultivated as sole crop throughout the

country in *Rabi* season and sometimes as mixed crop in farmer's field.

It is observed that, some farmers of Amtali upazila under Baguna district and Dumki upazila under Patuakhali district are cultivating chickpea and mustard as a mixed crop without calculating benefit, cost and return in varying seed ratio. Mixed cropping is the agricultural practice of cultivating two or more crops in the same piece of land at the same time (Ofori and Stern, 1987; Anil *et al.*, 1998). It offers effective weed suppression, pest and disease control, and use of soil resources under organic farming systems (Bulson *et al.*, 1997; Theunissen, 1997; Jensen *et al.*, 2005).

It is a simple and inexpensive strategy and has been recognized as a potentially benefitted technology to increase crop production due to its substantial yield advantage than sole cropping (Awal *et al.*, 2006). The purpose of intercropping is to generate beneficial biological interactions between the crops. Intercropping can increase yields, more efficiently use available resources, reduce weed, insect and disease pressures and provide greater biological and economic stability (Vandermeer, 1989).

Patuakhali and Barguna region is a distinctive physiologic unit in the southern part of Bangladesh. This area is characterized by heavy clay soil, heavy rainfall from May to October, cyclone, tidal flooding twice a day during wet season, high soil salinity and scarcity of sweet water for irrigation in the dry season, shorter winter season, late harvesting of T. *Aman* rice, etc. Chickpea is mostly grown as a single crop for a long period after harvest of T. *Aman* rice but a lot of plants is damaged at seedling stage due to lack or excess of soil moisture, soil born diseases, etc. which causes low plant stand and lower yield. In that situation mixed cropping is a good option. Hence, the present study was therefore, undertaken to identify the appropriate ratio of chickpea with Mustard for growing as a mixed crop in the coastal area and to ensure the maximum utilization of the land resource for higher yield and economic return.

Materials and methods

An experiment was conducted at MLT site Amtali, Barguna and FSRD site Rzakhali, Dumki, Patuakhali in the *rabi* season of 2014-2015 to verify the performance of Chickpea and mustard as a mixed crop in the coastal area under farmers field condition. The experimental areas belong to the Low Ganges River Floodplain (AEZ 13). It was consisted with six treatments as follows: T₁: 100% Chickpea @ seed rate 55 Kg ha⁻¹, T₂: 100% Mustard @ seed rate 7 Kg ha⁻¹, T₃:100% chickpea + 15% Mustard, T₄: 100% chickpea + 20% Mustard, T₅: 100% chickpea + 25% Mustard, T₆: 100% chickpea + 30% Mustard. The experiment was laid out in RCB design with six dispersed replications having unit plot size 40 m² (8 m x 5 m). BARI released variety BARI Chola-5 & BARI Sorisa-14 was used for this experiment. According to the treatments, seeds of Chickpea and Mustard were broadcasted on 11-15 December 2014. The plot was fertilized with 18-16-15-1 kg/ha N-P-K-B. Standard

cultural practices (irrigation, mulching, weeding and thinning) and plant protection measure were done as and when necessary. Mustard was harvested on 26-28 February 2015, whereas chickpea on 15-20 April 2015. Data on the different yield and yield contributing parameters were collected from the 06 sample plants and then average was taken which was further analyzed by computer program MSTAT-C. Chickpea Equivalent Yield (CEY) and economic analysis were calculated to ascertain the efficiency of intercropping. Chickpea Equivalent Yield (CEY) was calculated according to Bandyopadhyay (1984):

$$\text{Chickpea Equivalent Yield (CEY)} = \frac{\text{Yield of Mustard (Kg/ha)} \times \text{Price of Mustard (Tk./Kg)}}{\text{Price of Chickpea (Tk./Kg)}}$$

Result and discussion

Yield and yield attributes of Chickpea

The results indicated that most of the yield attributes of Chickpea were significantly influenced due to mixed cropping with Mustard in both the locations (Table 1 & Table 2).

Table 1. Yield attributes of Chickpea as a mixed crop with Mustard during Rabi season of 2014- 15 at FSRD Site Dumkiin Patuakhali.

Treatments	Plant height (cm)	Plant population/m ²	No. of pods plant ⁻¹	No. of seeds pod ⁻¹	1000 seed weight (g)
T ₁ : 100% Mustard	-	-	-	-	-
T ₂ : 100% Chickpea	55.75	41.60	31.40	1.60	126.50
T ₃ :100% chickpea + 15% Mustard	52.15	28.80	26.75	1.60	120.00
T ₄ : 100% chickpea + 20% Mustard	50.05	26.70	25.55	1.55	127.50
T ₅ : 100% chickpea + 25% Mustard	47.90	26.90	25.50	1.50	124.00
T ₆ : 100% chickpea + 30% Mustard	44.90	23.60	24.45	1.45	120.00
CV (%)	3.75	6.77	5.20	7.14	4.31
LSD (0.05)	3.54	3.57	2.08	0.19	9.34

Table 2. Yield attributes of Chickpea as a mixed crop with Mustard during Rabi season of 2014- 15 at MLT Site Amtali in Barguna.

Treatments	Plant height (cm)	Plant population/m ²	No. of pods plant ⁻¹	No. of seeds pod ⁻¹	1000 seed weight (g)
T ₁ : 100% Mustard	-	-	-	-	-
T ₂ : 100% Chickpea	37.7	48.2	28.0	1.9	132.0
T ₃ :100% chickpea + 15% Mustard	37.8	42.5	26.0	1.7	122.0
T ₄ : 100% chickpea + 20% Mustard	39.7	40.5	23.5	1.7	120.0
T ₅ : 100% chickpea + 25% Mustard	38.5	39.8	23.0	1.6	119.0
T ₆ : 100% chickpea + 30% Mustard	37.0	37.8	22.5	1.6	119.0
CV (%)	5.87	8.03	10.44	8.87	2.10
LSD (0.05)	3.18	16.68	4.55	0.27	4.41

The plant height, population, number of pod plant⁻¹ and 1000 seed weights were gradually decreased with increasing rate of mustard mixed with chickpea in both Dumki and Amtoli site. Among the mixing treatments the highest chickpea yield was recorded in

sole situation 1500 kg ha⁻¹ at Dumki and 1300 kg ha⁻¹ at Amtali followed by 100% chickpea + 15% Mustard (1130 kg ha⁻¹ & 850kg ha⁻¹ respectively), might be due to cumulative effect of chickpea-mustard mixing ratios.

The lowest chickpea yield was recorded in the treatment of 100% chickpea + 30% Mustard (685 kg ha⁻¹ & 580 kg ha⁻¹) in both the locations. The tallest plants with bolder size grains of chickpea were produced in sole condition that reduced with increased rate of mustard.

Consequently sole chickpea produced the highest grain yield of 1520 kg/ha and 1390 kg/ha at Dumki and Amtoli respectively. Chickpea equivalent yields in the mixed cropping treatments were significantly higher than the sole cropping.

Table 3. Yield attributes of Mustard as a mixed crop with Chickpea during Rabi season of 2014- 15 at FSRD site Dumkiin Patuakhali.

Treatments	Plant height (cm)	Plant population /m ²	No. of pods plant ⁻¹	No. of seeds pod ⁻¹	1000 seed weight (g)	Mustard grain yield (kg/ha)
T1: 100% Mustard	99.0	63.5	47.0	24.4	3.0	1450
T2: 100% Chickpea	-	-	-	-	-	-
T3: 100% chickpea + 15% Mustard	97.0	28.0	43.5	24.6	2.9	870
T4: 100% chickpea + 20% Mustard	99.5	39.5	31.9	24.2	3.0	910
T5: 100% chickpea + 25% Mustard	97.0	46.5	40.1	24.1	3.1	1020
T6: 100% chickpea + 30% Mustard	97.0	47.5	38.7	23.8	2.8	890
CV (%)	1.01	2.25	3.45	0.69	7.92	9.20
LSD	1.86	1.76	0.77	0.29	0.41	

Table 4. Yield attributes of Mustard as a mixed crop with Lentil during Rabi season of 2014- 15 at MLT site, Amtali, Barguna.

Treatments	Plant height (cm)	Plant population/m ²	Nos. of pods plant ⁻¹	Nos. of seeds pod ⁻¹	1000 seed weight (g)
T1: 100% Mustard	102.4	52	48	29	3.4
T2: 100% Chickpea	-	-	-	-	-
T3: 100% chickpea + 15% Mustard	108	36	41	28	2.9
T4: 100% chickpea + 20% Mustard	102	38	47	28	3.0
T5: 100% chickpea + 25% Mustard	100	42	36	26	3.2
T6: 100% chickpea + 30% Mustard	98	48	38	27	2.9
CV (%)	3.05	2.8	14.13	2.25	8.11
LSD (0.05)	1.956	2.123	16.99	1.095	0.548

Among the mixed cropping treatments the highest Chickpea Equivalent yield (1730 kg/ha and 1575 kg/ha) was observed from 100% chickpea + 15% Mustard (T₃) and the lowest (1180 kg/ha and 1210 kg/ha) from 100% Mustard (T₁) in both Dumki and Amtali site respectively (Fig. 1 & Fig. 2). Samsuzzaman *et al.* (1995) evaluated the performance of mustard and chickpea intercropping at different levels and got best results considering yield and

economic returns from mustard 75%+chickpea 25% among other combinations. Singh and Rathi (2003) got higher productivity for intercropping of chickpea and mustard in the 4:1 row ratio than for sowing of chickpea and mustard in sole stands in terms of land equivalent ratio. Mamun *et al.*, (2002) intercropped mustard with chilli at different seedling ratios and got higher yield and profit in seedling ratio as: 26% mustard+100% chilli.

Table 5. Cost and return analysis of the treatments at FSRD site Dumki, Patuakhali during Rabi season 2014-15.

Treatments	Gross return (Tk ha ⁻¹)	TVC (Tkha ⁻¹)	Gross margin (Tk ha ⁻¹)	BCR
T1: 100% Mustard	70800	56530	14270	1.25
T2: 100% Chickpea	91220	56530	34690	1.61
T3: 100% chickpea + 15% Mustard	103800	59540	44260	1.74
T4: 100% chickpea + 20% Mustard	98400	59540	38860	1.65
T5: 100% chickpea + 25% Mustard	79380	59540	19840	1.33
T6: 100% chickpea + 30% Mustard	84300	59540	24760	1.41

Note: Chickpea @ 60 Tk/kg and Mustard @ 50 Tk/kg, CEY=Chickpea Equivalent Yield.

Yield and yield attributes of Mustard

Yield attributes of mustard are presented in the Table 3 and Table 4. Results indicated that plant populations of mustard were varied with the percent

amount of seeds used among the treatments. It was revealed that the higher number of pod plant⁻¹ (47 at Dumki & 48 at Amtali) was recorded in T₁ (Sole Mustard).

Table 6. Cost and return analysis obtained from the experimentation conducted at MLT Site, Amtali, Barguna during Rabi season 2014-15.

Treatments	Gross return(Tk ha ⁻¹)	TVC (Tkha ⁻¹)	Gross margin (Tk ha ⁻¹)	BCR
T1: 100% Mustard	72600	57530	15070	1.26
T2: 100% Chickpea	83400	57680	25720	1.44
T ₃ :100% chickpea + 15% Mustard	94500	59320	35180	1.59
T ₄ : 100% chickpea + 20% Mustard	87960	59360	28600	1.48
T ₅ : 100% chickpea + 25% Mustard	88800	59400	29400	1.49
T ₆ : 100% chickpea + 30% Mustard	79260	59440	19820	1.33

Note: Chickpea @ 60 Tk/kg and Mustard @ 50 Tk/kg, CEY= Chickpea Equivalent Yield.

The lowest number of pod plant⁻¹ (31.9 at Dumki & 36.0 at Amtali) was obtained from T₄ (100% Chickpea + 20 % mustard) T₅ (100% Chickpea + 25 % mustard) respectively. The maximum seed yield of mustard was obtained (1415 kg ha⁻¹ at Dumki & 1450 kg ha⁻¹ at

Amtali) in T₁ (sole mustard) and the minimum (685 kg ha⁻¹) was obtained from T₆: 100% chickpea + 30% Mustard and (870 kg ha⁻¹) was obtained from T₃:100% chickpea + 15% Mustard in Dumki & Amtali site respectively (Fig. 1 & Fig. 2).

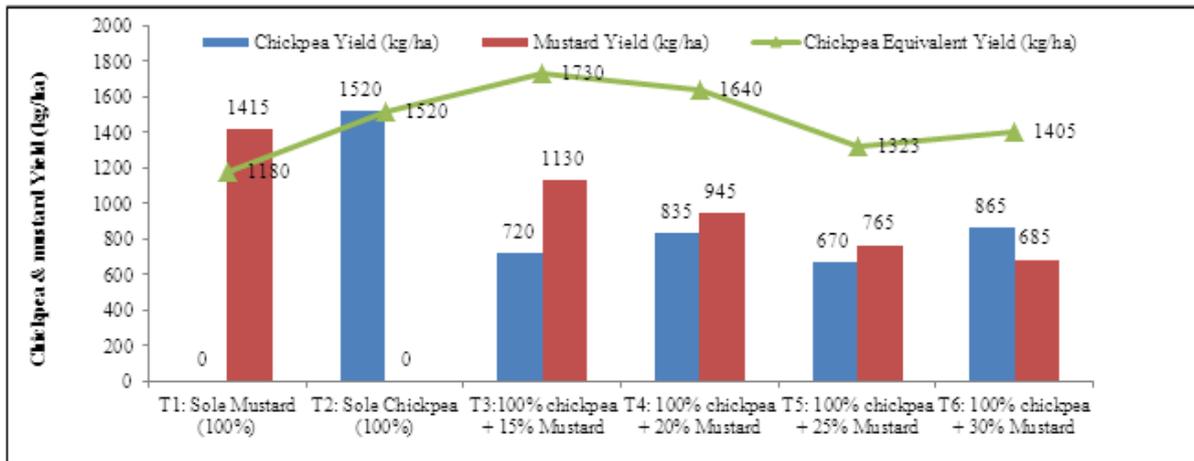


Fig. 1. Comparison of Chickpea, Mustard and Chickpea equivalent yield as sole & mixed situation at Dumki site.

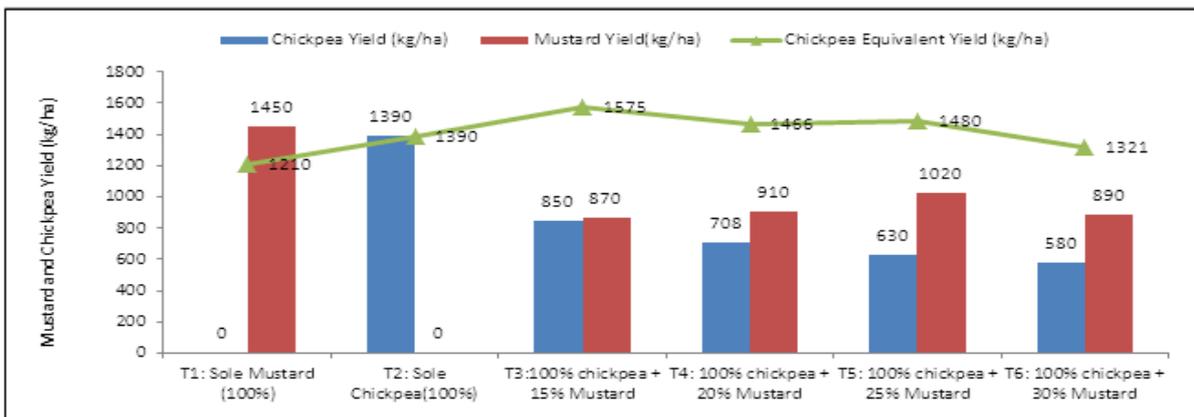


Fig. 2. Comparison among chickpea, mustard and chickpea equivalent yield as a sole and mixed situation at Amtali.

Cost and return analysis

Cost, return data and BCR were presented in the Table 5 and 6. Gross return as well as gross margin was found higher in mixed crop cultivation in comparison to sole cropping. From cost and return analysis, it was observed that T₃ treatment (100 % Chickpea + 15 % mustard) gave the highest gross margin Tk. 44260 ha⁻¹ & Tk.35180 ha⁻¹ and the lowest gross margin (Tk.14270 ha⁻¹ and Tk. 15070 ha⁻¹) was obtained from sole Mustard (T₁) from both Dumki and Amtali locations respectively. The highest BCR 1.74 & 1.59 was also recorded from T₃ treatment. Many researchers also documented higher gross margin or net return in mixed/intercropping system than sole crop (Sarker and Pal, 2004; Razzaque *et al.*, 2007; Alam *et al.*, 2008).

Conclusion

Considering the yield and return it can be concluded that 100% Chickpea with 15% mustard is the most profitable as compared to other treatment combination when grown as mixed crop in coastal region of Bangladesh. From the result of this experimentation it is evident that, mixed cropping is more profitable than the sole cropping and risk of cultivation of one crop can be reduced by mixed cropping.

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