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Intermixed cropping of garden pea with onion

Jubaidur Rahman[1*], AHM Motiur Rahman Talukder[2], A.K.M. Zonayed-ull-Noor[3], Mukaddasul Islam Riad[4], Fouzia Sultana Shikha[5], Md. Mizanur Rahman[6], Nahid Kaisar[7], Lutfun Nahar[8]

[1]*Agronomy Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh*
[2]*Plant Physiology Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh*
[3]*Seed Technology Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh*
[4]*Plant Genetic Resources Centre, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh*
[5]*Soil Science Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh*
[6]*Horticulture Research Centre, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh*
[7]*Department of Soil Science, Bangladesh Agricultural University, Mymensingh- 2202, Bangladesh*
[8]*Agronomy Division, Bangladesh Rice Research Institute, Gazipur-1701, Bangladesh*

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Correspondence:

Jubaidur Rahman
E-mail: jubaidurjp@gmail.com
Phone: +880-1728-112992

ABSTRACT

An experiment was conducted at the Regional Agricultural Research Station, Jamalpur during rabi season of 2013-2014 and 2014-2015 to find out optimum plant population of garden pea under intermixed cropping with onion for maximize land use efficiency and economic return. The highest bulb yield (10.3 and 11.0 t ha^{-1}) was obtained from sole onion while the lowest from 100% onion (broadcast) + 50% garden pea (75 cm × 5 cm) (broadcast) in two consecutive years (5.5 and 6.3 t ha^{-1}, respectively). Pod yield varied among the different treatment combination due to the different ratios of garden pea. The highest pod yield (9.11 1st yr. and 9.31 2nd yr.) was obtained from sole garden pea (30 cm × 5 cm) in line sowing while the lowest (5.15 1st yr. and 2nd yr 5.73) from 100% onion (broadcast) + 50% garden pea (75 cm × 5 cm) following broadcasting in both the years. Bulb yield of onion was reduced due to intermixed cropping with garden pea compared to sole onion but addition of garden pea yield with onion it increased total productivity of intermixed cropping which is expressed in onion equivalent yield (OEY). The highest OEY for 100% onion (broadcast) + 80% garden pea (37.5 cm × 5 cm) in line sowing was (19.7 in 1st yr. and 19.8 in 2nd yr., respectively) while in case of 100% onion (broadcast) + 60% garden pea (50 cm × 5 cm) in line sowing it was 18.93 for 1st yr. and 21.6 for 2nd yr., respectively. Intercropping increased land use efficiency which is expressed in land equivalent ratio (LER) and it was higher in any of the intermixed cropping treatment compared to sole onion. In the 1st year maximum gross margin was recorded in 100% onion (broadcast) + 80% garden pea (line sowing) followed by the 100% onion (broadcast) + 60% garden pea but in the 2nd year it was obtained from the combination of 100% onion (broadcast) + 60 % garden pea followed by the 100% onion (broadcast) + 80% garden pea (line sowing). Therefore, cultivation of garden pea with onion would be more profitable than sole cropping of onion.

Introduction

Intercropping can be explained as a system where two or more crop species are grown in the same field at the same time during a growing season (Ofori & Stern, 1987). It is a simple and inexpensive strategy and has been recognized as a potentially befitted 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). Intercropping has been an essential production method in tropical regions for hundreds of years (Vandermeer, 1989) and to a lesser extent in temperate regions (Li et al., 2001). Intercropping was once common in temperate regions, but has been largely replaced in the last 150 years by monocultures (Francis, 1986).

Intercropping is the most common practice to the farmers of Bangladesh, because it increases the total productivity per unit area through the maximum utilization of land, labour and growth resources (Ahmed et al., 2006). The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources that would other wise not be utilized by a single crop. Better intercrop production could be achieved with the choice of appropriate crops (Santalla et al., 2001), population density and planting geometry of component species/crops (Myaka, 1995). Greater productivity in intercropping system is commonly achieved by minimizing inter-specific competition and maximizing complementary use of growth resources (Islam, 2002). Among the intercropping practices sweet gourd with onion intercropping is a common practice to the farmers of char areas. On the other hand, onion is a herb species and it has a preservative and medicine uses (Vohra et. al., 1994). It has been compared cropping systems over three successive seasons (monsoon, winter and summer) in India (Prabhakar et. al., 1990).

In another study, intercropping of pearl millet with cowpea or groundnut showed their significant effects on soil and crop productivity after either sole or intercrop system (Reddy et. al., 1992). To optimize the planting density, the seedling rate of each crop on the mixture has been suggested to adjust below the full rate to reduce competition from overcrowding. Thus, intercrops yield was found to be increased in the mixture stand compared to sole stand (Hiebsch et. al., 1980). Plant architecture allows one intercrop to capture sunlight that would not otherwise be available to others. This phonological character is particularly important to growth and yield of cereals and legume crops (Reddy et. al., 1981; Gardiner et. al., 1981). Depending on the crops to be intercropped, competition for water, light and nutrients may results in lower yields. In this case changes in the spatial arrangement of the intercrops will reduce resource competition (Reddy et. al. 1981).

Due to decreasing cultivable land, some farmers of char areas (river flood plain areas) under greater Mymensingh district in Bangladesh have been practicing char land areas of Bangladesh in Sherpur and Jamalpur district farmers generally cultivate the garden pea and onion as an intermixed cropping. Garden pea has a great demand in market as vegetables while onion has also a great demand as vegetables and spices. In spite of high demand of these vegetables to the local and foreign market farmers could not increase the total productivity through the intercropping practices due to the lacking of proper combination of planting geometry. As a result the farmers are depriving of a handsome yield as well as economic return. Therefore, the study was undertaken to find out the optimum population of garden pea under intermixed cropping with onion.

Methods and materials

The experiment was conducted at the Regional Agricultural Research Station, Jamalpur during *rabi* 2013-2014 and 2014-2015. Through this study, we tried to find out the optimum population of garden pea as with inter mixed cropped with onion and maximize the land utilization and economic return. The mixed-intercropping were sole onion (broadcast), sole garden pea (30 cm × 5 cm) in line sowing, 100% onion (broadcast) + 80% garden pea (37.5 cm × 5 cm) in line sowing, 100% onion (broadcast) + 60% garden pea (50 cm × 5 cm) in line sowing and 100% onion (broadcast) + 40% garden pea (75 cm × 5 cm) in line sowing, and 100% onion (broadcast) + 50% garden pea (75 cm × 5 cm) (broadcast).

Design of the experiment was randomized complete block with three replications having the unit of plot 5 m × 3 m. Garden pea var. BARI Motorshuti 3 along with onion var. BARI Peaj 1 was used as a variety at different planting combinations. Onion seeds were sown on broadcast system @ 7 kg seed ha^{-1} while garden pea was sown in lines. Fertilizers were applied for sole onion and intercrop at the rate of 60-30-80-20-2.0-0.7 kg ha^{-1} N-P-K-S-Zn-B. For sole onion and intercropping systems half of nitrogen and all other fertilizers were applied during the final land preparation and reaming half of nitrogen was top dressed at 25 and 50 DAS (days after sowing). For sole garden pea fertilizers were applied @ 30-14-20-6-0.7 kg ha^{-1} N-P-K-S-Zn, respectively. For sole garden pea all fertilizers were applied during the final land preparation. For garden pea and onion irrigation was applied at fifteen days after emergence. Onion was sown on 19 November, in both the years (2013 and 2014) and on the same day's different ratio of garden pea was sown in a line according to the intercropping combinations.

Intercultural operations like irrigation, weeding and pesticide application were followed as and when required. Bulb yield for onion was calculated in tha^{-1} considering the whole plot harvest area. Garden pea was harvested by hand picking on the basis of maturity at 25 and 35 days after sowing and yield was calculated in fresh weight t ha^{-1}. For yield and yield contributing characters ten bulb of onion was collected randomly from each treatment to collect the length and breadth of bulb.

Collected data were analyzed statistically with the help of MSTAT-C programme and mean separation was done as per LSD test at 5% level of significance. Economic analysis was performed considering the price of prevailed at the harvesting period in the local market. Onion equivalent yield was also calculated considering the local market price at the harvesting time following the formula as stated by Aujeneyulu et al. (1982). Intercropping efficiency in terms of LER was calculated according to Mead & Willey (1980) using the formula: LER = Ya/Sa + Yb/Sb; where, Ya and Yb = individual crop yields in intercropping and Sa and Sb= the crop yield as sole crop. The LER is the most common index for measuring the advantages of using intercropping systems on the combined yield of both crops (Francis & Decoteau, 1993). The LER was calculated as the yield of a crop in an intercrop system relative to the yield of that crop in a monocrop system.

Results and discussion

Yield and yield contributing character of onion

All the variables of onion differed significantly among the different inter mixed cropping combination (Table 1). In 1st year the tallest plant was obtained from the sole onion (broadcast) while the dwarf plant was obtained from the 100% onion (broadcast) + 80% garden pea (37.5 cm × 5 cm) in line sowing and from the second year tallest plant was obtained from the 100% onion (broadcast) + 80% garden pea (37.5 cm × 5 cm) in line sowing while the dwarf plant was obtained from the sole onion (broadcast). In first year 100% onion (broadcast) along with 60% garden pea (50 cm × 5 cm) line sowing and 40% garden pea (75 cm × 5 cm) line sowing produced the moderate plant height and second year 100% onion (broadcast) + 40%

garden pea (75 cm × 5 cm) in line sowing produced the moderate plant height.

In both the years sole onion (broadcast) produced significantly maximum bulb length while the 100% onion (broadcast) along with 40% garden pea (line sowing) produced the satisfactory bulb length. 100% onion (broadcast) + 50% garden pea (75 cm × 5 cm) (broadcast) produced the minimum bulb length. Similar trends were observed in bulb breadth. In both the years sole onion produced the maximum 10-bulb weight that was statistically similar to the intercropping of 100% onion (broadcast) + 60% garden pea (50 cm × 5 cm) (line sowing) and 100% onion (broadcast) + 40% garden pea (75 cm × 5 cm) in line sowing. The sole onion (broadcast) produced the significantly maximum bulb yield. Among the intercropping system the bulb yield was drastically reduced when 50% garden pea was being broadcasted.

Among the intercropping system the bulb yield was increased with the decreasing of garden pea ratio. The pod yield of garden pea was gradually decreased with the decreasing of the seeding ratio. The maximum pod yield 9.11 tha^{-1}(1^{st} year) was obtained from the sole garden pea and the minimum garden pea yield 5.15 tha^{-1} was obtained from the 100% onion (broadcast) + 50% garden pea (75 cm × 5 cm) (broadcast). Similar trend was found in the second year experiment. The maximum onion equivalent yield 19.7 tha^{-1} (1^{st} year) was obtained from 100% onion (broadcast) + 80% garden pea (37.5 cm × 5 cm) (line sowing) while the minimum was obtained from the sole onion.

In second year the maximum onion equivalent yield 21.6 tha^{-1} was obtained from 100% onion (broadcast) + 60% garden pea (50 cm × 5 cm) in line sowing while the minimum was obtained from the sole onion. In first year the maximum LER (1.54) was obtained from the 100% onion broadcast + 80% garden pea line sowing followed by the (1.52) 100% onion broadcast + 60% garden pea line sowing and second year the maximum land equivalent ratio (1.86) was obtained from the 100% onion (broadcast) + 50% garden pea (75 cm × 5 cm) (broadcast) followed by the (1.68) 100% onion (broadcast) + 60% garden pea (50 cm × 5 cm) in line sowing.

Table 1. Yield and Yield attributes of onion in onion-garden pea intermixed cropping system during *rabi* season of 2013-2014 and 2014-2015.

Cropping system	Plant height (cm)		Bulb length (cm)		Bulb breadth(cm)		Wt. of 10- bulb (g)	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
T_1	51.9	48.7	3.12	3.22	3.80	3.89	207	212
T_2	-	-	-	-	-	-	-	-
T_3	44.2	52.2	2.98	2.97	3.40	3.36	158	163
T_4	47.4	52.1	2.82	3.01	3.33	3.26	185	198
T_5	46.0	51.7	3.02	3.14	3.54	3.63	185	195
T_6	45.2	49.4	2.80	2.85	3.28	3.30	158	161
CV (%)	3.26	6.46	3.21	4.89	3.71	7.53	6.99	8.97
F-test	**	NS	*	NS	**	NS	**	**
$LSD_{0.05}$	2.89	-	0.20	-	0.24	-	23.5	15.23

Table 1. Yield and Yield attributes of onion in onion-garden pea intermixed cropping system during *rabi* season of 2013-2014 and 2014-2015 (Cont'd).

Cropping system	Bulb yield (t ha^{-1})		Pod yield (t ha^{-1})		OEY (t ha^{-1})		LER	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
T_1	10.3	11.0	-	-	10.3	11.0	1.00	1.00
T_2	-	-	9.11	9.31	14.5	14.8	1.00	1.00
T_3	6.3	6.5	8.43	8.51	19.7	19.8	1.54	1.51
T_4	7.77	9.3	7.02	7.71	18.93	21.6	1.52	1.68
T_5	8.60	8.4	5.24	5.86	16.9	17.7	1.41	1.40
T_6	5.50	6.3	5.15	5.73	13.69	15.4	1.10	1.86
CV (%)	6.79	9.63	3.9	4.3	-	-	-	-
F-test	**	**	*	*	-	-	-	-
$LSD_{0.05}$	0.98	2.20	6.0	5.6	-	-	-	-

Y1= 1st year, Y2= 2nd year

T_1 = sole onion (broadcast), T_2 = sole garden pea (30 cm × 5 cm) (line sowing), T_3 = 100% onion (broadcast) + 80% garden pea (37.5 cm × 5 cm) (line sowing), T_4 = 100% onion (broadcast) + 60% garden pea (50 cm × 5 cm) (line sowing) and T_5 = 100% onion (broadcast) + 40% garden pea (75 cm × 5 cm) (line sowing), T_6 = 100% onion (broadcast) + 50% garden pea (75 cm × 5 cm) (broadcast).

Table 2. Economic performances of onion garden pea intermixed cropping system during rabi season of 2013- 2014 and 2014-2015.

Cropping system	Yield t ha^{-1}				Total cost of cultivation (Tk ha^{-1})		Gross return (Tk ha^{-1})		Gross margin (Tk ha^{-1})	
	Onion		Garden pea							
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
T_1	10.3	11.0	-	-	55245	55245	226600	242000	171355	186755
T_2	-	-	9.11	9.31	30000	30000	318850	325850	288850	295850
T_3	6.3	6.5	8.43	8.51	75245	75245	434050	440850	358405	365605
T_4	7.77	9.3	7.02	7.71	68555	68555	416700	474850	348085	406295
T_5	8.60	8.4	5.24	5.86	65455	65455	372400	390100	307145	324645
T_6	5.50	6.3	5.15	5.73	60554	60554	301250	339550	240696	278996

Y1= 1st year, Y2= 2nd year; Price: Onion Tk. 22 kg^{-1}, Garden pea Tk. 35 kg^{-1}
T_1 = sole onion (broadcast), T_2 = sole garden pea (30 cm × 5 cm) (line sowing), T_3 = 100% onion (broadcast) + 80% garden pea (37.5 cm × 5 cm) (line sowing), T_4 = 100% onion (broadcast) + 60% garden pea (50 cm × 5 cm) (line sowing) and T_5 = 100% onion (broadcast) + 40% garden pea (75 cm × 5 cm) (line sowing), T_6 = 100% onion (broadcast) + 50% garden pea (75 cm × 5 cm) (broadcast).

Economic performance

In first year the maximum cost of cultivation Tk. 75245 ha^{-1} was found in the onion (100% broadcast) + 80% garden pea (line sowing) while the minimum was in Tk. 30000 ha^{-1} in sole garden pea (Table 2) and in the second year similar result was observed. The intercropping of onion (100% broadcast) + 80% garden pea in line sowing produced the maximum gross return Tk. 434050 ha^{-1} and the gross margin Tk. 288850 ha^{-1} and in second year 100% onion (broadcast) + 60% garden pea (50 cm × 5 cm) in line sowing produced the maximum gross return Tk. 474850 ha^{-1} and the gross margin Tk. 406295 ha^{-1}.

Conclusion

Cultivation of garden pea with onion was found more profitable than sole cropping of onion. The farmers could obtain maximum gross margin from the combination of 100% onion (broadcast) + 80% garden pea (line sowing) or 100% onion (broadcast) + 60% garden pea (line sowing).

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