Bangladesh Agron. J. 2025, 28(1): 29-34

INTERCROPPING OF SUMMER ONION WITH MUKHIKACHU

M. A. H. Khan[1]*, M. Rahman[2], T. Husna[2], S. Akther[1], M. J. Islam[3]

[1]Agronomy Division, Bangladesh Agricultural Research Institute, Gazipur
[2]Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Cumilla
[3]Upazila Agriculture Office, Barura, Cumilla
*Corresponding author, Email: ayubagronomy@yahoo.com

(**Received:** 14 October 2025, **Accepted:** 21 November 2025)

Keywords: Intercrop, mukhikachu, summer onion

Abstract

An experiment was conducted at the research field of Regional Agricultural Research Station (RARS), Bangladesh Agricultural Research Institute (BARI), Cumilla during *Kharif* I, 2022 to find out the suitable combination of onion with mukhikachu for increasing total productivity, economic return and maximize land utilization through intercropping system. Seven treatments viz., i) Sole mukhikachu ii) Two rows of summer onion in between two rows of mukhikachu iii) Three rows of summer onion in between two rows of mukhikachu iv) Two rows of summer onion in between two double rows of mukhikachu v) Three rows of summer onion in between two double rows of mukhikachu vi) Sole summer onion. The trial was set up in a randomized complete block design with three replications. The unit plot size was 3.0 m × 2.70 m. The mukhikachu was (Var. BARI Mukhikachu-1) a main crop and onion (Var. BARI Peaz-5) were used as intercrops in the study. The sole crop of mukhikachu was planted at a spacing of 60 cm × 45 cm, the sole crop of onion at a spacing of 15 cm × 10 cm. Results showed that, different intercropping combination significantly influenced yield and yield contributing characters of mukhikachu. The yield of mukhikachu was comparatively lower in intercropping than sole mukhikachu but total productivity was increased due to additional yield of onion. Increased total productivity in terms of mukhikachu equivalent yield (MEY) was 38.72-42.28 t ha^{-1} in intercrop combination compared to sole mukhikachu 31.70 t ha^{-1} (main crop). All the intercropping combinations showed better performance in terms of mukhikachu equivalent yield, gross return and benefit cost ratio (BCR) over sole crops. Among the intercropping combinations three rows of onion in between two double rows of mukhikachu was the most feasible intercropping system in respect of mukhikachu equivalent yield (42.28 t ha^{-1}), gross return (Tk.8,45600), gross margin (Tk. 5,18100) and benefit cost ratio (2.58). Three rows of summer onion in between two rows of mukhikachu (BCR 2.56) and two rows of summer onion in between two double rows of mukhikachu (BCR 2.51) were also feasible intercrop combination.

Introduction

Intercropping is a common practice of crop cultivation to increase the productivity per unit area and ensure against total crop failure under aberrant weather condition. It increases total productivity per unit area through maximum utilization of land, labor and growth resources. It also increases land equivalent ratio (LER) to a varying degree (Hossain and Bari, 1996). Successful intercropping system gives higher cash return, total production per hectare and diversifies production system than sole cropping and provides greater resources use efficiency. Yield advantage in intercropping are mainly due to efficient utilization of resources such as light, water and nutrients than respective sole crop (Liu *et al.*, 2006). Other potential benefits of intercropping include high productivity and profitability (Yildirim and Guvence, 2005), increase in soil fertility through nitrogen fixation by addition of leguminous crop in intercropping system (Hauggaard-

Nielsen *et al.*, 2001), reducing damage caused by pests, weeds and diseases (Banik *et al.*, 2006), improvement of quality of forage (Barillot *et al.*, 2014) and use of environmental resources efficiently (Eskandari and Ghanbari, 2010).

Onion (*Allium cepa*) is one of the most important spices as well as vegetable crops of Bangladesh. It is widely cultivated during winter season. But now-a-days some onion varieties are also cultivate in summer season. Summer onion cultivation can be a new way to increase the onion production in Bangladesh and make it available throughout the year. Consequently, demand of onion will be met up and employment opportunity will be created. This crop may be harvest within very short time. Onion could be cultivated in between two rows of mukhikachu as an extra or inter-crop. Mukhikachu (*Colocasia esculenta var. globulifera* L.) is an important edible aroid in Bangladesh as well as in some other countries of the world. It occupies about 80% of the total aroid production in the country (Bhuiyan and Ahmed, 2001). Mukhikachu is rich in vitamin A, C, iron and calcium. In Bangladesh, it comes to market as an important summer vegetable when most of the vegetables are not available. It plays a vital role to meet up the demand of vegetables in the lean period. After plantation, the crop requires six months for shoot growth. Then it declines and cormel growth starts and continues to grow about 2 to 3 months till maturity, in this condition 8-9 months are required for cultivation of mukhikachu. The rate of mukhikachu emergence and subsequent growth are very slow. The emergence starts at 25-30 days after planting and it continues up to 50 to 60 days. Its growth becomes rapid at later stage when soil moisture is sufficient by rainfall.

Intercropping of summer onion with mukhikachu is a way to avoid direct competition with other crops and to familiarize its potentiality to the farmers. Summer onion being a short duration (70-80 days) crop can be intercropped easily with long duration (210-280 days) wider spaced mukhikachu. They have also different growth habit and demand for growth resources. The return from intercropping is higher and more profitable than those from the relevant sole crops. So, if mukhikachu and summer onion can be grown as intercrop, the farmers may be benefited economically. The findings on intercropping mukhikachu with summer onion and their suitable ratio is not available. Hence, an experiment was undertaken to find out the suitability of intercropping summer onion with mukhikachu for higher productivity and profitability at varying combinations.

Materials and Methods

A field experiment has been conducted at research field of Regional Agricultural Research (RARS) Station, Bangladesh Agricultural Research Institute (BARI), Cumilla during Kharif I 2022. The treatments were: i) Sole mukhikachu ii) Two rows of summer onion in between two rows of mukhikachu iii) Three rows of summer onion in between two rows of mukhikachu iv) Two rows of summer onion in between two double rows of mukhikachu v) Three rows of summer onion in between two double rows of mukhikachu vi) Sole summer onion. BARI Mukhikachu-1 (main crop) and BARI Peas-3 (component crop) were used as variety. The trial was set up in a randomized complete block design (RCBD) with three replications. The unit plot size was 3.0 m × 2.70 m. Sole mukhikachu and intercrop treatments were fertilized with N-P-K-S 96-27-81-18 kg ha^{-1} respectively. Full amount of PKS was applied as basal. N was applied in two equal splits, one at 20 days after planting (DAP) and another at 45 DAP. The sole crop of normal mukhikachu was planted at a spacing of 60 cm × 45 cm, in case of double rows mukhikachu was planted 55 cm × 20 cm × 45 cm. Mukhikachu was planted on 14 March 2022. Forty days old onion seedling was transplanted on 16 March 2022. The onion seedling was transplanted at a spacing of 15 cm × 10 cm. Irrigation and pesticide were applied as per necessary. Weeding was done at 25, 45 and 60 days after transplanting.

For, mukhikachu data on yield and yield contributing characters were taken and analyzed statistically. The yield component data of mukhikachu and onion was taken from 10 randomly selected plants prior to harvest from each plot. For mukhikachu and onion at harvest the yield data were recorded plot wise. The collected data were analyzed statistically using statistix 10 package and means were adjudged by LSD at 5% level of probability. Mukhikachu equivalent yield (MEY) was converted by converting yield of intercrops on the basis of market price of individual crop following the formula:

$$\text{Mukhikachu Equivalent Yield} = \text{Yield of intercrop Mukhikachu} + \frac{Yi \times Pi}{\text{Price of Mukhikachu}}$$

Where, Yi = Yield of intercrop (Onion) and Pi = Price of intercrop (Onion).
Land equivalent ratio (LER) values were determined from the yield data of the crops by the following equation:

$$\text{LER} = \frac{YiC}{\text{Y syc}} + \frac{Yicc}{\text{Ysycc}}$$

Where,
Yic= Intercrop yield of Mukhikachu
Ysyc = Sole yield of Mukhikachu
Yicc = Intercrop yield of component crop (onion)
Ysycc = Sole yield of component crop (onion)

Results and Discussion

Yield and yield attributing characters of Mukhikachu

Plant height, number of corm plant^{-1}, corm weight plant^{-1}, number of cormel plant^{-1}, cormel weight plant^{-1} and yield were significantly influenced due to sole and intercropping onion with mukhikachu (Table 1). The highest plant height (112.33) was obtained from T_1 and the lowest (103.33 cm) was found in T_2 treatment. The highest number of corm plant^{-1} (10.8), and cormel plant^{-1} (30.2) was recorded in (T_5) treatment. The highest cormel wt. plant^{-1} (517.5 g) was obtained from sole mukhikachu (T_1) which was statistically similar with T_5 (515.0 g) and T_4 (512) treatment. The highest yield (31.70 t ha^{-1}) was obtained from T_1 treatment and the lowest (28.80 t ha^{-1}) was observed from T_2 treatment. Islam *et al.* (2014) also reported similar result.

Table 1. Yield and yield attributes of mukhikachu under sole and intercropping situation during Kharif 2022

Treatments	Plant height (cm)	Corm plant^{-1} (no.)	Corm weight plant^{-1} (g)	Cormel plant^{-1} (no.)	Cormel weight plant^{-1} (g)	Yield (t ha^{-1})
T_1	112.33	8.87	488	29.0	517.5	31.70
T_2	103.33	8.13	493	25.4	434.0	28.80
T_3	107.27	9.73	507	27.6	468.7	29.20
T_4	108.73	10.2	508	29.8	512.0	30.30
T_5	108.47	10.8	471	30.2	515.0	31.00
$LSD_{(0.05)}$	5.3	2.1	NS	3.2	32.7	2.1
CV(%)	8.4	5.6	9.8	11.2	7.5	9.5

i) T_1- Sole mukhikachu ii) T_2- Two rows of summer onion in between two rows of mukhikachu iii) T_3-Three rows of summer onion in between two rows of mukhikachu iv) T_4- Two rows of summer onion in between two double rows of mukhikachu v) T_5- Three rows of summer onion in between two double rows of mukhikachu.

Yield and yield attributes of intercrop onion

Branch plant^{-1}, bulb height, bulb diameter, single bulb weight and yield were significantly influenced due to sole and intercropping onion (Table 2). The highest branch plant^{-1} (6.13 cm) was obtained from T_6 and the lowest (5.86 cm) was in T_5 treatment. The highest bulb height (5.00 cm) was recorded in T_3 treatment which was identical to T_4, T_5 and T_6 treatment. The highest bulb diameter (3.70 cm) was obtained from sole onion (T_6) which was statistically similar (3.60) with T_2 treatment. The highest single bulb weight (24.93 g) was obtained from sole onion (T_6) which was statistically similar (23.73) with T_4 treatment and the lowest (22.07 g) was recorded in T_2 treatment. The highest onion bulb yield (8.38 t ha^{-1}) was obtained from T_6 treatment and the lowest (4.96 t ha^{-1}) was achieved from T_2 treatment. The highest yield was obtained might have the effect of the highest single bulb weight in sole crop. Islam *et al.* (2014) also reported similar result. Dahmardeh *et al.* (2009) also observed that yield of intercropping system is often higher than in sole cropping system.

Table 2. Yield of onion under sole and intercropping situation during Kharif I 2022

Treatments	Plant height (cm)	Branch plant^{-1} (no.)	Bulb height (cm)	Bulb diameter (cm)	Single bulb weight (g)	Yield (t ha^{-1})
T_2	37.13	5.93	4.63	3.60	22.07	4.96
T_3	35.33	5.93	5.00	3.37	23.00	6.34
T_4	35.40	5.93	4.97	3.50	23.73	5.22
T_5	37.33	5.86	4.80	3.33	22.27	5.64
T_6	39.20	6.13	4.93	3.70	24.93	8.38
LSD(0.05)	NS	0.18	0.22	0.10	1.42	-
CV(%)	10.5	9.8	8.8	8.7	8.9	5.8

i) T_1- Sole mukhikachu ii) T_2- Two rows of summer onion in between two rows of mukhikachu iii) T_3 -Three rows of summer onion in between two rows of mukhikachu iv) T_4- Two rows of summer onion in between two double rows of mukhikachu v) T_5- Three rows of summer onion in between two double rows of mukhikachu vi) T_6 -Sole summer onion.

Mukhikachu Equivalent Yield

Mukhikachu equivalent yield is expressed in total productivity. Mukhikachu equivalent yield were higher (38.72 - 42.28 t ha^{-1}) in all the intercrops than the sole crop of mukhikachu (31.70 t ha^{-1}) and onion (16.76 t ha^{-1}). In intercrop combination, the highest mukhikachu equivalent yield (42.28 t ha^{-1}) was recorded in T_5 treatment (Three rows of summer onion in between two double rows of mukhikachu) which was followed by (41.88 t ha^{-1}) T_3 treatment (Three rows of summer onion in between two rows of mukhikachu) and the lowest mukhikachu equivalent yield (16.76 t ha^{-1}) was obtained from T_6 treatment (Sole onion). Ahmed et al. (2013) also reported that intercrop combination increase the equivalent yield.

Table 3. Mukhikachu equivalent yield (MEY), Land equivalent ratio (LER) and Cost and return analysis of mukhikachu and onion under sole and intercropping situation at RARS, BARI, Cumilla

Treatments	MEY (t ha^{-1})	LER	Gross return (Tk. ha^{-1})	Cost of production (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	Benefit cost ratio (BCR)
T_1	31.70	1.00	634000	275000	359000	2.30
T_2	38.72	1.81	774400	325000	449400	2.38
T_3	41.88	2.07	837600	327500	510100	2.56
T_4	40.74	1.90	814800	325000	489800	2.51
T_5	42.28	2.00	845600	327500	518100	2.58
T_6	16.76	1.00	335200	165000	170200	2.03

CEY= Chilli equivalent yield; LER= Land equivalent ratio, i) T_1- Sole mukhikachu ii) T_2-Two rows of summer onion in between two rows of mukhikachu iii) T_3 -Three rows of summer onion in between two rows of mukhikachu iv) T_4- Two rows of summer onion in between two double rows of mukhikachu v) T_5- Three rows of summer onion in between two double rows of mukhikachu vi) T_6 -Sole summer onion.

Cost Benefit Analysis

Intercropping combination of onion with mukhikachu showed higher monetary return than sole crop (Table 3). The highest gross return (Tk. 8,45600) was recorded from T_5 treatment (Three rows of summer, onion in between two double rows of mukhikachu) which was 33.3% higher than the sole mukhikachu. This intercropping combination (T_5) also gave the higher gross margin (Tk. 5,18100) and benefit cost ratio (2.58) followed by T_3 treatment (Three rows of summer onion in between two rows of mukhikachu) with 2.56 BCR. The results of increased productivity and returns were consistent with the earlier reports of yield advantages of crop mixture compared to monoculture (Islam *et al.*, 2012 and Ahmed *et al.*, 2013). Munir *et al.* (2004) also observed that higher net income and benefit cost ratio was observed in wheat gram intercropping system.

Conclusion

The result revealed that, all intercropping treatments were productive as compared to sole treatments. Among the treatments, T_5 onion with mukhikachu combination (Three rows of summer onion in between two double rows of mukhikachu) were more productive and profitable in respect of CEY and monetary return. Three rows of summer onion in between two rows of mukhikachu (T_3) and two rows of summer onion in between two double rows of mukhikachu (T_4) combinations were also profitable in respect of MEY and BCR.

Acknowledgment

The authors are greatly thankful to the "Upgrading Regional Horticulture Research Station, Cumilla to Regional Agricultural Research Station project" for the financial and technical support during the experimentation.

References

Ahmed, F., M.N. Islam, M.S. Alom, M.A.I. Sarker and M.A. Mannaf. 2013. Study on intercropping leafy vegetables with okra (*Abelmoschus esculentus* L.). Bangladesh J. Agril. Res. 38(1): 137-143.

Banik, P., A. Midya, B.K. Sarkar, and S.S. Ghose. 2006. Wheat and chickpea intercropping systems in an additive series experiment: Advantages and weed smothering. Eur. J. Agron. 24: 325-332.

Barillot, R., A.J. Escobar-Gutiérrez, C. Fournier, P. Huynh and D. Combes. 2014. Assessing the effects of architectural variations on light partitioning within virtual wheat–pea mixtures. Ann. Bot., mcu 099.

Bhuiyan, M.K.R. and M.S. Ahmed. 2001. Varietal improvement and development of production package of aroids in diversified areas in Bangladesh. A final report. Contract research project. Agricultural Research Management Project (ARMP) IDA Credit281 5-BD, Bangladesh Agricultural Research Council, Dhaka. pp. 1-2.

Dahmardeh, M., A. Ghanbari, B.S. Syasar and M. Ramroudi. 2009. Effect of intercropping maize with cowpea on green forage yield and quality evaluation. Asian J. Plant Sci. 8: 235-239.

Eskandari, H. and A. Ghanbari. 2010. Effect of different planting pattern of wheat (*Triticum aestivum* L.) and bean (*Vicia faba*) on grain yield, dry matter production and weed biomass. Not. Sci. Biol. 2: 111-115.

Hauggaard-Nielsen, H., P. Ambus and E.S. Jensen. 2001. Temporal and spatial distribution of roots and competition for nitrogen in pea-barley intercrops. A field studies employing 23 P techniques. Plant Soil. 236: 63-74.

Hossain, M.A. and A.K.M.A. Bari.1996. Effect of intercropping groundnut with garlic at varying plant population levels. Bangladesh Hort. 24(1-2): 29-34.

Islam, M.R., M.A.K. Mian and M.T. Rahman. 2012. Suitability of intercropping sesame with mukhikachu leafy vegetables and legumes with brinjal. Bangladesh J. Agril. Res. 37(4): 625-634.

Islam, M.R., M.T. Rahman, M.F. Hossain and N. Ara. 2014. Feasibility of intercropping leafy vegetables and legumes with brinjal. Bangladesh J. Agril. Res. 39(4): 685-692.

Liu, J.H., Z.H. Zeng, L.X. Jiao, Y.G. Hu, Y. Wang and H. Li. 2006. Intercropping of different silage maize cultivars and alfalfa. Acta. Agron. Sci. 32: 125-130.

Munir, M., M. Saeed and M. Imran. 2004. Crop productivity and net return in wheat- gram intercropping. Pakistan J. Agric. Res. 18: 20-24.

Yildirim, E. and I. Guvence. 2005. Intercropping based on cauliflower: more productivity, profitable and highly sustainable. Eur. J. Agron. 22: 11-18.