

## PRODUCTIVITY OF POTATO - HYBRID MAIZE RELAY CROPPING SYSTEM AS INFLUENCED BY FERTILIZER DOSE

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### Abstract

The experiment was conducted at research field of Agricultural Research Station, BARI, Comilla during November 2012 to June 2013 with a view to find out economic fertilizer dose for potato- hybrid maize relay cropping system. The potato variety BARI Alu-7 and the maize variety BARI Hybrid Maize-7 were used. Seven fertilizer combinations viz. T<sub>1</sub>= Farmers fertilizer dose of potato (FFDP) + without additional fertilizer for maize (WAFM), T<sub>2</sub>= FFDP + 100% N of recommended fertilizer dose of hybrid maize (RFDM), T<sub>3</sub>= FFDP + 100% N & 25% others of RFDM, T<sub>4</sub>= FFDP + 100% N & 50% others of RFDM, T<sub>5</sub>= Recommended fertilizer dose of potato (RFDP) +100% N of RFDM, T<sub>6</sub>= RFDP +100% N & 25% others of RFDM and T<sub>7</sub>= RFDP +100% N & 50% others of RFDM were tested on potato-hybrid maize relay cropping system. Farmer's fertilizer dose for potato was 504-162-309 kg ha<sup>-1</sup> NPK. Recommended fertilizer dose for potato and hybrid maize was 198-44-194-24-6-1.2 kg ha<sup>-1</sup> NPKSZnB and 255-55-140-40-6-2 kg ha<sup>-1</sup> NPKSZnB, respectively. The highest potato equivalent yield (37.80 t ha<sup>-1</sup>) and gross return (4,53,600 Tk. ha<sup>-1</sup>) were obtained from T<sub>3</sub> treatment. But the maximum gross margin (Tk. 3,03,075 Tk. ha<sup>-1</sup>) was found from treatment T<sub>1</sub> and the highest benefit cost ratio (3.14) was observed in T<sub>5</sub> which was close to T<sub>1</sub> (3.06) and T<sub>6</sub> (3.0). The results revealed that recommended fertilizer dose of potato and 100% N from recommended fertilizer dose of hybrid maize might be used for potato hybrid maize relay cropping system for getting higher economic return at Comilla region.

### Introduction

Potato is a tuber crop having potential yield of 25-35 t ha<sup>-1</sup> in Bangladesh. Hybrid maize is a cereal crop with capacity of producing about 8-11 t ha<sup>-1</sup> of grain yield. Both the crops have diversified uses and a wide range of production area in our country. Potato and maize may be grown as relay crop as they have different growth habit and growth duration. Potato maize relay cropping is a system in which maize is sown after attaining the reproductive stage or before maturity of potato. This relay cropping practice is a common and popular practice in different location in our country. The wider plant spacing of hybrid maize provides facility of other crops for growing as inter or relay cropping with it (Ahmed *et al.*, 2010). Farmers in some area practice this system to avoid early flood as well as drought. They sow maize 20-25 days before potato harvest resulting higher grain yield compared to maize sown after potato harvest. Moreover, fertilizer application is an option for increasing productivity of potato hybrid maize relay cropping. As life cycle of potato and hybrid maize is different, so the fertilizer requirement and its management practices also vary. (Islam *et al.*, 2013). Most of the farmers of these areas use residual fertilizer in potato but they do not use any fertilizer or only little amount of N fertilizer for maize under relay cropping system. Moreover, split application of fertilizer to component crops increased total productivity as well as fertilizer use efficiency through reducing leaching loss

of nutrients (Gill and Ahmed, 1985; Ceretta *et al.*, 2002). However, literatures regarding economic fertilizer management for potato hybrid maize relay cropping system are meager. Therefore, the experiment was conducted to find out economic fertilizer dose and management practices for potato-hybrid maize as relay cropping system.

## Materials and Methods

The experiment was conducted at research field of Agricultural Research Station, BARI, Comilla during November 2012 to June 2013. The experiment was laid out in randomized complete block design with three replications. The unit plot size was 3m x 3m. In case of potato, the row to row distance was 60cm and plant to plant distance was 25cm. Seven treatments namely T<sub>1</sub>= Farmers fertilizer dose of potato (FFDP) + without additional fertilizer for maize (WAFM), T<sub>2</sub>= FFDP + 100% N of recommended fertilizer dose of hybrid maize (RFDM), T<sub>3</sub>= FFDP + 100% N & 25% others of RFDM, T<sub>4</sub>= FFDP + 100% N & 50% others of RFDM, T<sub>5</sub>= Recommended fertilizer dose of potato (RFDP) +100% N of RFDM, T<sub>6</sub>= RFDP +100% N & 25% others of RFDM and T<sub>7</sub>= RFDP +100% N & 50% others of RFDM. FFDP= Farmers Fertilizer Dose of Potato = 504-162-309 kg ha<sup>-1</sup> of NPK, FFDM= Farmers Fertilizer Dose of hybrid maize =0-0-0 kg ha<sup>-1</sup> of NPK, RFDP= Recommended Fertilizer Dose of Potato = 198-44-194-24-6-1.2 k kg ha<sup>-1</sup> NPKSZnB, RFDM= Recommended Fertilizer Dose of Maize = 255-55-140-40-6-2 kg ha<sup>-1</sup> NPKSZnB. The tubers of potato variety *BARI Alu-7* were planted on 27 November, 2012. The fertilizers were applied according to the treatments. Rouging, irrigation and other intercultural operations were done as and when necessary. Insecticide (Admire) was sprayed 3 times, beginning from 25 days after planting (DAP) at every 10 days interval. Fungicide (Diathene M-45) was sprayed at 30 DAP for prevention of disease and Secure was sprayed at 40, 50 and 60 days after planting for protection of disease. All necessary data were taken at the period of harvesting. In potato, half of N and all other fertilizers were applied as basal. Rest amount of N was top dressed at 30 days after potato planting. Potato was harvested at 90 days after planting on 25 February, 2013. Hybrid Maize variety BARI Hybrid Maize 7 was sown in between two potato rows after 71 days of potato planting on 06 February, 2013. The seeds of maize were treated with Bavistin @ 1 g L<sup>-1</sup> for controlling foot and root rot disease. The insecticide Darsban 100 EC @ 4.5 ml L<sup>-1</sup> was sprayed at afternoon three times at the rate of 5 ml L<sup>-1</sup> for controlling cutworm. The row to row distance was 60cm and seed to seed distance was 20cm, respectively. In maize, half of N and all other fertilizers were applied just after potato harvesting. Rest N was top dressed after 30 days of maize sowing. Maize was harvested on June 03, 2013 (117 DAS). Yield components of potato and maize were taken from randomly selected 10 plants from each plot. Yields of both the crops were taken from whole plot. Equivalent yields were computed using the formula of Bandyopadhaya (1984). Data on yield and yield components of both the crops were analyzed statistically and the means were adjudged using LSD test. Benefit- cost analysis was also done.

## Results and Discussion

### Potato

Significant differences were observed in yield and yield contributing characters of potato among the treatments (Table 1). The highest plant height (61 cm) was recorded from T<sub>1</sub>, that was statistically similar to T<sub>2</sub> (60.9 cm) and T<sub>3</sub> (59.9 cm). Maximum (9.4) and minimum (7.8) numbers of tuber per plant were obtained from T<sub>1</sub>, T<sub>2</sub> and T<sub>6</sub> respectively where as T<sub>1</sub> and T<sub>2</sub> was statistically identical with T<sub>5</sub> and T<sub>3</sub>. The highest weight of tuber per plant (608.53 g) was observed in T<sub>1</sub> which was statistically similar to T<sub>2</sub> (578.66 g) and T<sub>3</sub> (521.53 g) and the lowest from T<sub>7</sub> (395.26 g). The highest tuber yield (27.7 t ha<sup>-1</sup>) was obtained from the treatment T<sub>1</sub>

*Potato-Hybrid Maize Relay Cropping*

that was statistically similar to T<sub>3</sub> (27.30 t ha<sup>-1</sup>), T<sub>2</sub> (27.00 t ha<sup>-1</sup>), T<sub>5</sub> (25.50 t ha<sup>-1</sup>) and T<sub>6</sub> (25.7 t ha<sup>-1</sup>) and the lowest (23.23 t ha<sup>-1</sup>) from T<sub>7</sub>. To achieve high tuber quality it is recommended to fertilize less with nitrogen and to increase phosphorus and potassium fertilizer rates (Vos, 1999). Baniuniene and Zekaitė (2008) observed that of mineral fertilizers, the most effective were found to be the phosphorus and potassium combinations with nitrogen fertilizer, under the effect of which the yields increased by 32-93 %.

Table 1. Effect of fertilizer dose on yield and yield attributing characters of potato at research field of ARS, Comilla during the *rabi* 2012-13

Fertilizer dose	Plant height (cm)	Tuber plant <sup>-1</sup> (no.)	Tuber wt. plant <sup>-1</sup> (g)	Tuber yield (t ha <sup>-1</sup> )
T <sub>1</sub> : FFDP + WAFM	61.0	9.40	608.53	27.70
T <sub>2</sub> : FFDP + 100%N of RFDM	60.9	9.40	578.66	27.00
T <sub>3</sub> : FFDP + 100%N & 25% others of RFDM	59.9	8.60	521.53	27.30
T <sub>4</sub> : FFDP + 100%N & 50% others of RFDM	54.9	8.00	477.46	25.46
T <sub>5</sub> : RFDP + 100%N of RFDM	52.2	9.20	505.86	25.50
T <sub>6</sub> : RFDP + 100%N & 25% others of RFDM	52.8	7.80	484.20	25.70
T <sub>7</sub> : RFDP + 100%N & 50% others of RFDM	50.9	7.90	395.26	23.23
LSD <sub>(0.05)</sub>	3.91	1.29	96.20	2.11
CV (%)	3.92	8.43	10.60	4.57

FFDP= Farmers Fertilizer Dose of Potato = 504-162-309 kg ha<sup>-1</sup> of NPK, WAFM= without additional fertilizer for maize, RFDP= Recommended Fertilizer Dose of Potato = 198-44-194-24-6-1.2 kg ha<sup>-1</sup> NPKSZnB, RFDM= Recommended Fertilizer Dose of Maize = 255-55-140-40-6-2 kg ha<sup>-1</sup> NPKSZnB

### Hybrid maize

Grain yields and yield components of hybrid maize did not differ for different fertilizer management practices (Table 2). However, the highest cobs m<sup>-2</sup> (7.13) was found from T<sub>3</sub> and the lowest (7.03) was found from T<sub>6</sub>. The highest grains cob<sup>-1</sup> (518.96) was found from T<sub>7</sub> and the lowest (458.03) was found in T<sub>2</sub>. The highest thousand grain weight (288.0) was found in T<sub>5</sub> and the lowest (272.0) in T<sub>4</sub>. The highest grain yield (10.50 t ha<sup>-1</sup>) was observed from T<sub>3</sub> which was followed by T<sub>4</sub>, T<sub>5</sub>, T<sub>2</sub>, T<sub>1</sub>, T<sub>6</sub> and the lowest (9.16 t ha<sup>-1</sup>) was found from T<sub>7</sub>. Ceretta *et al.* (2002) also reported higher grain yield of corn due to split application of fertilizer. This result was supported by the findings of Chand *et al.* (2001).

Table 2. Effect of fertilizer dose on Yield and yield components of hybrid maize in potato-hybrid maize relay cropping at Comilla during the *rabi* 2012-13

Fertilizer dose	Cobs m <sup>-2</sup> (no.)	Grains cob <sup>-1</sup> (no.)	1000 Seed wt. (g)	Grain yield (t ha <sup>-1</sup> )
T <sub>1</sub> : FFDP + WAFM	7.10	514.96	287.33	9.79
T <sub>2</sub> : FFDP + 100%N of RFDM	7.10	458.03	279.33	9.86
T <sub>3</sub> : FFDP + 100%N & 25% others of RFDM	7.13	509.00	276.00	10.50
T <sub>4</sub> : FFDP + 100%N & 50% others of RFDM	7.10	515.50	272.00	10.02
T <sub>5</sub> : RFDP + 100%N of RFDM	7.10	511.10	288.00	10.02
T <sub>6</sub> : RFDP + 100%N & 25% others of RFDM	7.03	499.00	275.33	9.45
T <sub>7</sub> : RFDP + 100%N & 50% others of RFDM	7.10	518.96	279.33	9.16
LSD <sub>(0.05)</sub>	NS	NS	NS	NS
CV (%)	1.84	3.41	6.77	10.04

FFDP= Farmers Fertilizer Dose of Potato = 504-162-309 kg ha<sup>-1</sup> of NPK, WAFM= without additional fertilizer for maize, RFDP= Recommended Fertilizer Dose of Potato = 198-44-194-24-6-1.2 kg ha<sup>-1</sup> NPKSZnB, RFDM= Recommended Fertilizer Dose of Maize = 255-55-140-40-6-2 kg ha<sup>-1</sup> NPKSZnB

### Potato equivalent yield

Potato equivalent yield and benefit-cost analyses are presented in Table 3. The highest potato equivalent yield (37.8 t ha<sup>-1</sup>) was recorded from T<sub>3</sub> and the lowest from T<sub>7</sub> (32.39 t ha<sup>-1</sup>). The treatment T<sub>3</sub> gave the highest gross return (4,53,600 Tk. ha<sup>-1</sup>) that was followed by T<sub>1</sub>, T<sub>2</sub>, T<sub>5</sub>, T<sub>4</sub>, T<sub>6</sub> and the lowest (3,88,680 Tk. ha<sup>-1</sup>) from T<sub>7</sub>. The cost of cultivation was maximum (1,67,897 Tk. ha<sup>-1</sup>) in T<sub>4</sub> and minimum (1,35,449 Tk. ha<sup>-1</sup>) in T<sub>5</sub>. The cost of production mainly increased with the increase of fertilizer cost as well as involvement of more labour for management practices. The highest gross margin (3,03,075 Tk. ha<sup>-1</sup>) was obtained from T<sub>1</sub> and the lowest (2,43,199 Tk. ha<sup>-1</sup>) from T<sub>7</sub>. Maximum benefit-cost ratio (3.14) was achieved from T<sub>5</sub>, which was followed by T<sub>1</sub>, T<sub>6</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>7</sub> and minimum (2.53) from T<sub>4</sub> treatment. Akhteruzzaman *et al.* (2008) also obtained more benefit from intercropping due to judicious application of fertilizers.

Table 3. Potato equivalent yield (PEY) and benefit-cost analysis of potato-hybrid maize relay cropping under different fertilizer management at Comilla during the *rabi* 2012-13

Fertilizer dose	PEY (tha <sup>-1</sup> )	Gross return (Tk. ha <sup>-1</sup> )	Cost of cultivation (Tk. ha <sup>-1</sup> )	Gross margin (Tk. ha <sup>-1</sup> )	BCR
T <sub>1</sub> : FFDP + WAFM	37.49	4,49,880	1,46,805	3,03,075	3.06
T <sub>2</sub> : FFDP + 100%N of RFDM	36.86	4,42,320	1,57,865	2,84,455	2.80
T <sub>3</sub> : FFDP + 100%N & 25% others of RFDM	37.80	4,53,600	1,62,881	2,90,719	2.75
T <sub>4</sub> : FFDP + 100%N & 50% others of RFDM	35.48	4,25,760	1,67,897	2,57,863	2.53
T <sub>5</sub> : RFDP + 100%N of RFDM	35.52	4,26,240	1,35,449	2,90,791	3.14
T <sub>6</sub> : RFDP + 100%N & 25% others of RFDM	35.15	4,21,800	1,40,465	2,81,335	3.00
T <sub>7</sub> : RFDP + 100%N & 50% others of RFDM	32.39	3,88,680	1,45,481	2,43,199	2.67

Market price (Tk. kg<sup>-1</sup>): Potato 12/- and Maize 12/-

FFDP= Farmers Fertilizer Dose of Potato = 504-162-309 kg ha<sup>-1</sup> of NPK, WAFM= without additional fertilizer for maize, RFDP= Recommended Fertilizer Dose of Potato = 198-44-194-24-6-1.2 kg ha<sup>-1</sup> NPKSZnB, RFDM= Recommended Fertilizer Dose of Maize = 255-55-140-40-6-2 kg ha<sup>-1</sup> NPKSZnB

### Conclusion

Based on the present study, it may be concluded that recommended fertilizer dose of potato and 100% N from recommended fertilizer dose of hybrid maize could be used for potato hybrid maize relay cropping system for getting higher economic return.

### References

- Ahmed, F., M. N. Islam, M. T. Rahman, M. A. Jahan and M. S. A. Khan. 2010. Leaf area index, radiation interception, dry matter production and grain yield of hybrid maize as influenced by plant spacing. *Bangladesh Agron. J.* 13(1 & 2): 51-58.
- Akhteruzzaman, M., M. N. Islam, B. L. Nag and M. T. Rahman. 2008. Productivity of potato-hybrid maize relay cropping under different fertilizer levels. *Eco-friendly Agril. J.* 1(5): 300-303.
- Bandyopadhyay, S. N. 1984. Nitrogen and water relations in grain sorghum-legume intercropping systems. Ph. D. Dissertation, Indian Agricultural Research Institute, New Delhi.
- Baniuniene A. and V. Zekaite. 2008. The effect of mineral and organic fertilizers on potato tuber yield and Quality. *Latvian J. Agron.*, No.11, LLU, 2008.

*Potato-Hybrid Maize Relay Cropping*

- Ceretta, C. A., C. J. Basso, J. Diekow, C. Aita, P. S. Pavinato, F. C. B. Vieira, E. R. O. Vendrusculo. 2002. Nitrogen fertilizer split-application for corn in no-till succession to black oats. *Scientia Agricola* 59(3): 549-554.
- Chand, S. P., H. C. Lee, D. H. Scarisbrick and F. E. Tollervey. 2001. Potato (*Solanum tuberosum*) intercropped with maize (*Zea mays*) in the Eastern Hills of Nepal. *Japanese J. Trop. Agric.* 45(3): 167-175.
- Gill, M. A. and A. Ahmad. 1985. Effect of split application of nitrogenous fertilizer on the yield and Yield components of wheat. *Pakistan J. Agric. Res.* 6(2): 86-88.
- Islam, M. N., M. Akhteruzzaman, and M. S. Alom. 2013. Split application of inorganic fertilizers in potato (*Solanum tuberosum* L.) - hybrid maize (*Zea mays* L.) intercropping system. *Bangladesh J. Agril. Res.* 38(3): 447-453.
- Vos, I. 1999. Split nitrogen application in potato: effects of accumulation nitrogen and dry matter in the crop and on the soil nitrogen budget. *Journal Agric. Sci.* 199-274.